THE

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CONTENTS:

	PAGE
The Light that Fails...	81
Apparatus for Use in Experimental Fused Electrolysis (*illus.*)	83
The Electro-Chemical and Electro-Metallurgical Industries in 1899 (*concluded*)	84
Recent Papers on the Commutation of the Direct Current Dynamo (*illustrated*) (*continued*)	86
Sanding on Tramway Tracks	87
Joseph Henry (*illustrated*) (*concluded*)	88
The City Lighting (*illustrated*)	90
Correspondence:—The Century Problem	91
An Explanation	92
The Use of Rubber Insulated Wire in Steel Conduits ...	92
Electric Riveters	92
Legal	92
The Metropolitan Electric Supply Company's Supply	93
On the Protection of Electric Power Transmissions from Lightning (*illustrated*) (*continued*)	94
Review...	95
Business Notices, &c.	96
Bolton Corporation Electricity Works (*illustrated*)	101
Supply Station Accounts	111
City Notes	112
Traffic Receipts	112
Stocks and Shares	112
Share List of Electrical Companies	113
Market Quotations	114
Gasoline Gas for Boiler Heating	115
Standardising in Engineering Construction	115
Large Electric Light Engines	115
Electric Driving in Dyeing and Calico Printing Works ...	116
Power Losses in the Machine Shop	116
An American Pacific Cable (*continued*)	117
Some Suggestions to the Managers of Small Central Stations	118
The Electrical Fire Bogey	120
Some Interesting Faults on Telephone Circuits (*illustrated*) ...	120
Electrical Fly-wheel Governors (*illustrated*)	121
The Institution of Electrical Engineers	122
New Patents	123
Abstracts of Published Specifications	123

THE

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1900

Edition

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THE LIGHT THAT FAILS.

THERE is no argument which so readily appeals to the human intellect as an actual demonstration with one's own person as the subject of experiment. This has been brought home to us in a most forcible manner of late. We happen to derive our supply of electricity from the mains of the City of London Company, which is supposed to maintain a constant pressure of 100 volts at our terminals; nevertheless, our lamps on several occasions have faded away, as one of the financial papers puts it, "like the Cheshire cat," leaving nothing but a ghostly glimmer in the bulb. The state of affairs was aptly summarised by an anonymous voice from the end of our composing room, proceeding from some one lost in the gloom:—"*If our grandfathers were to wake up they'd think we are still using rushlights!*"

As a matter of fact we were using candles, which caused the electric lamps—once incandescent, but now, alas! well-named *glow* lamps—to throw their shadow on the wall.

A voltmeter test on one of these occasions showed that we were supplied at a pressure of 86 volts; this discovery induced us to make a continuous test with a recording voltmeter, the result of which is given on another page.

Inquiry of the company elicited the statement that the trouble is due entirely to the scarcity of coal; the plant is not overloaded, as is the case with some other stations, but it is impossible to get a sufficient supply of coal, good or bad, to maintain the full pressure when for any reason a heavy load comes on.

But it is not exactly clear why a heavy load should make the difference. It will be noticed, on reference to our records, that the failure—for it is a failure—takes place between 4 and 7 p.m., and that at other times the pressure is well maintained. Indeed, to do full justice to the company, we must compliment it on the steadiness of the pressure as a rule; the lower limit set by the Board of Trade is rarely overstepped—though when it is transgressed there is no mistake about it!—while a pressure 2 or 3 per cent. above the standard is, in most cases, rather welcomed than otherwise. It should be noted that the voltmeter was connected to a fuseboard in the basement, and the mean pressure at the lamps is probably not far from the normal when the voltmeter registers 1 or 2 per cent. more.

One can readily understand that after the generating plant of a supply authority is loaded to the full, the pressure must fall as the overload increases; but unless coal is purposely withheld during the time of heavy load, lest a *total* stoppage should result, why does the voltage go down when the plant is *not* overloaded?

A similar lack of coal is reported from Kingston, Islington, and other places, not forgetting the works of the Metropolitan Electric Supply Company, and it is generally set down to the heavy calls made by the Government upon the stocks of steam coal immediately available, for use in the transports conveying reinforcements and war material to South Africa.

D

While the scarcity may be to a large extent due to this cause, it is also true that the unprecedented activity in all branches of industry has so far depleted stocks that we even hear of blast furnaces being shut down for want of fuel.

In the present state of affairs the gas and electricity supply industries may be, for once, in harmony, for at more than one gasworks it has been found practically impossible to maintain the supply for precisely the same reason. It is impossible, under the circumstances, to severely criticise the supply authorities; they cannot help it, nor could they be expected to foresee such an extraordinary contingency. For the present all other interests must give way to the paramount necessities of the war, and we must wait as patiently as may be for peace and plenty of coal.

But, having in view the ever-present possibility of a prolonged coal strike, which would bring about an even more serious crisis, we trust that electricity supply undertakers will follow the wise example of the large gas companies, and lay in such large stocks of coal at the first opportunity that offers, that they may be able to tide over times of scarcity without these unsatisfactory failures, which are bound to inflict serious injury upon the industry.

Lack of space is no excuse, as the location of the coal store is of no consequence, and waste land is cheap and abundant.

Meanwhile, those few stations which derive their motive power from waterfalls, may congratulate themselves on the fact that, war or no war, their power costs no more, and its source can never be carried off to foreign climes!

We are sorry to think that there have recently been very many breakdowns all over the country, which are in no way attributable to the lack of coal—at Birmingham, Southampton, Redditch, Cardiff, Manchester, and other places—some due to defective mains, others to breakdown of the machinery. The moral effect of these repeated failures is most disastrous, and those responsible should adopt every possible precaution in order to avoid them, and to instantly restore the service when they occur. Otherwise the nickname with which we head this article will become only too accurate, and the gas men will be jubilant.

Liverpool Engineering Society.—The annual dinner of this Society took place on the 11th inst. at the Adelphi Hotel, Liverpool, Mr. A. Bromley Holmes, the president, in the chair. The *menu* was an interesting production, for the front page showed the electric power station in 1883 and the new building of 1900, the last page giving views of the electric tramways running and the interior of the power house. The Lord Mayor, in responding to a toast, did not stint his praise of the great triumphs of the engineering profession and the benefits it had given to Liverpool. Among other very happy references was one to the useful work which was being done by Mr. Bromley Holmes, the Corporation electrical engineer, and by Mr. Brodie, in connection with the tramways conversion. Dr. Tudsbery responded for the Institution of Civil Engineers. The President referred to the growth of the Society, which in 1876 had 51 members, and in 1900, 500. There were many things of which they were justly proud, one of these being the long list of eminent men who were among their honorary members; but while they had many grounds for congratulation, there were other matters less satisfactory to them as engineers. He proceeded as follows:—

It is not satisfactory that we should be losing our place in the world's markets as the leading manufacturers of machinery. It is unsatisfactory that we should have to go to America or Germany for plant we ought to be fully competent to make ourselves. Now I, for one, hold that an Englishman can do anything he sets himself to do, at any rate as well, if not better, than any one else, but his superiority is not so great as to enable him to do it with his eyes shut. We are apt to excuse ourselves on the ground of the lower wages paid on the Continent, but we shut our eyes to the better technical education and the better industrial finance of the great German nation. We recognise the ingeniously devised and beautifully constructed machinery by which the Americans produce repetition work, but we are apt to overlook the fact that the American pays higher wages than we do, and can afford to do so, as both employer and employed run the machinery for all that it is worth, and do not restrict the output. It is blind folly in this country to protest against and blame the combinations of labour to raise wages as the cause of all our difficulties. Combinations of labour are not only legal, but they are the absolute right of the worker, and, gentlemen, it will become serious ground for consideration, whether it will not be necessary for the professional classes to combine to secure a proportional increase in their rate of remuneration which has become necessary to bring it more in harmony with the increased wages of the so-called working classes. But although combinations of labour of every class are legal and right when properly used, they are harmful and wicked when employed to limit the freedom of others or to prevent the full use and development of machinery and resources of the country. The time will come when employer and employed in this country will recognise that their commercial existence depends on their adopting a more enlightened line of action than obtains at present. To that desirable end the influence of a society like our own, the members of which are in intimate touch with so much of the manufacturing industry of the community, ought to make itself felt. By combined and persistent effort in this and other similar directions, gentlemen, you can best secure the permanent prosperity of the Liverpool Engineering Society.

In a humorous speech Mr. S. B. Cottrell proposed "Our Guests." Mr. S. Z. Ferranti and Mr. C. Petrie responded.

The Institution of Electrical Engineers' Wiring Rules.—We have received from the secretary of the Institution of Electrical Engineers a copy of a circular, with a list of questions, that is now being sent out to all those who replied favourably to a notice previously issued on the same subject. We understand that a copy of these questions, which we reprint below, will, on application to the secretary, be sent to any electrical engineer who may be willing to assist the Institution in the attempt to promote uniformity in wiring rules.

Questions:—

1. Do you consider that regulations of some kind are necessary to ensure safe and durable wiring?
2. Presuming that you consider that there should be one set of standard regulations for ordinary risks for the United Kingdom, do you think that those which have been issued by the Institution cover sufficient ground; if not, in what direction do you suggest that they should be added to? Please give the suggested additions in the form you consider they should take.
3. Do you consider that the Institution regulations cover too much ground? If so, which portions should be omitted? Please give your reasons for suggesting their omission.
4. Do you agree with the general arrangement of the Institution rules?
5. Do you consider that any one regulation should be altered? If so, please say on what ground, and suggest in what way it can be improved.

Wood Casing and Tubes.—The following conditions have been laid down in the wiring rules prepared by Prof. Kennedy in connection with the three-wire system of supply by the Battersea Vestry:—

All conductors must be protected either by incombustible tubes or by hardened casing. If tubes are used, no elbows may be employed, but corners must be turned either by bends or by the use of a suitable box. Details of all such arrangements should be submitted to the engineer for his approval before they are carried out, in order that there may be no difficulty in approving the installation afterwards. Where wood casing is employed the conductors must be separated by a continuous fillet of wood which must not be less than $\frac{3}{4}$ inch wide, except with the very smallest branches, and must be increased up to $1\frac{1}{2}$ inches wide for main conductors. The capping must in all cases be secured by screws and not by nails, and the screws must be fixed in the outer edges of the casing, unless the middle fillet is at least $1\frac{1}{4}$ inches wide. If conductors have to be carried along damp walls they must either be run in iron or metal pipes, or if in wood casing they must be lead covered, and the casing itself blocked out from the wall at least $\frac{3}{4}$ inch. In the latter case, and wherever wood casing is to be embedded in plaster, it must be covered inside and outside with at least two coats of waterproof varnish. On no account must staples be used to fasten a conductor to any wall or ceiling. Wherever conductors are connected to switches, fuses, or other appliances, great care should be taken that the whole of the wires forming the conductor are neatly twisted and clamped into the terminal so that no loose wire or strand can project. The insulating material should only be bared back sufficiently to allow of the conductor entering into the terminals properly, and the ends of the insulation should be thoroughly sealed to prevent creeping of moisture. The braiding, lead, or other non or semi-insulating material should be cut back for a sufficient distance from the end of the insulating material.

APPARATUS FOR USE IN EXPERIMENTAL FUSED ELECTROLYSIS.

By ALEC. A. BEADLE.

Those who have attempted to overcome any of the difficulties in the electrolysis of fused salts have learned how many they are, and, farther, how little apparatus suitable for such work can be procured. The author, therefore, offers a few hints, gained from experience, which may be of service to those engaged in this line of investigation.

It is only proposed to deal with experimental work, and not pretend to throw any light upon the application of experiments to larger processes.

The various forms of furnace which can be obtained for ordinary metallurgical work are well known, and we will first see how these can be adapted to heating crucibles in such a manner as to facilitate the introduction of electrodes, &c., into them. Generally speaking, it is required to heat a crucible, and at the same time to be able to introduce electrodes and other paraphernalia into the top; the top should, therefore, be easy of access, and should not be exposed to the flame. It is often, too, necessary to have free access to the bottom of the crucible in order to introduce an electrode, or, perhaps, draw off metal or fused salts. The sides of the crucible should, then, be the only part exposed to the flame; draughts of cold air being of necessity excluded from those parts not in the furnace.

Fig. 1 shows one of Fletcher's ordinary draught furnaces as usually arranged. Fig. 2 represents it cut away so as to heat the sides of a crucible only, the top being passed

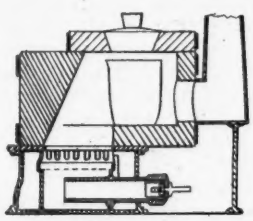

Fig. 1.

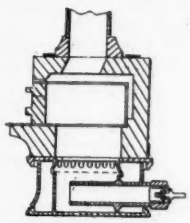

Fig. 2.

through a hole in the lid of the furnace, and being free for the introduction of electrodes, &c. The bottom is also protected from the flame.

These furnaces are made of beautifully soft material, and may be cut about, almost like cheese, without materially impairing their strength. This form of furnace is made in two sizes, the smaller size being designed ordinarily for crucibles not exceeding 3 inches high by $2\frac{5}{8}$ inches diameter. In fig. 2 it will be observed that the gas burner has been moved slightly to the left, and a small piece of the furnace cut away at A, in order to admit the whole of the flame.

Fig. 3 shows one of Fletcher's ordinary muffle furnaces. Fig. 4 shows it modified so as to heat a crucible instead of the muffle. This is, in some ways, more convenient than that shown in fig. 2, but the bottom of the crucible is in the

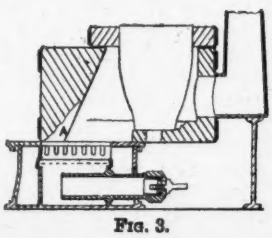

Fig. 3.

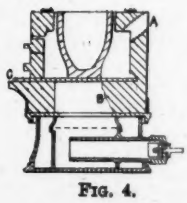

Fig. 4.

furnace, and cannot be easily got at. A hole is cut at A for the escape of the furnace gases; a small piece of fireclay should be put in at B, to direct the flame round the crucible. These furnaces are made in four sizes, the smallest taking, when modified, a crucible about 4 inches high.

Sufficient heat can be obtained in these furnaces to melt salt, brass, &c. They can also be procured with a blast arrangement, which enables a higher temperature to be produced; but if a much higher temperature is required, a more convenient form, and one that gives more satisfactory results, shown in fig. 5, may be used; the modified form is shown in fig. 6. This furnace is made in five sizes, the smallest, when modified, takes a crucible of about $3\frac{1}{4}$ inches high, the largest taking one of about 11 inches. By means of these blast furnaces a temperature sufficient to melt cast-iron can be obtained. There are several other forms of furnace, but the above are the most useful.

For small crucibles of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches high, when a high temperature is not required, Fletcher's small dental dome burner will be found most useful.

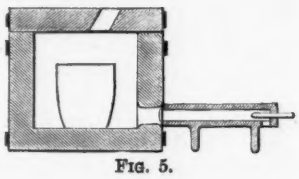

Fig. 5.

Fig. 7 shows a form of experimental furnace designed by Dr. Borchers. It is made more especially for the experimental electrolysis of magnesium salts, and is more suitable for the lecture table than those described above. It has a special fanged iron crucible shown at A. This furnace can

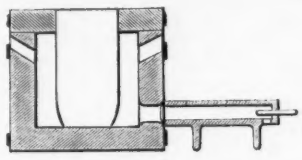

Fig. 6.

be obtained from Messrs. A. Gallenkamp & Co., 19, Sun Street, London, E.C.

At a few weeks' notice, Messrs. Doulton, of Lambeth, or the Morgan Crucible Company, will make furnace bodies of any

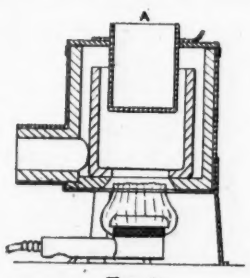

Fig. 7.

desired design and at a very reasonable cost. There are several forms of furnace which might be easily made, and would serve a useful purpose in the electro-chemical laboratory.

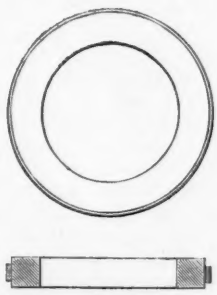

Fig. 8.

Simple rings, as shown in fig. 8, made of rectangular section and of any diameter, are capable of being built into a furnace of almost any desired form. These rings should each have an iron band to hold it together in the event of its cracking. Holes can be bored where required for the

entrance and exit of the flame; fire brick slabs serve as a base and cover.

The author has designed a form of furnace very useful on account of the fact that the top and bottom of the crucible are easily accessible; there is also good opportunity for supporting the electrodes on the top and bottom. It is shown in fig. 9; a movable door, E, made of fireclay, is also provided, so that when once electrolysis is started, if the flame is no longer required to keep the crucible hot, it may be inserted in place of the burner to exclude draughts of cold air. A is an ordinary draught gas burner, B a hole in the bottom of the furnace through which an electrode may be passed, D a strong iron stand for the furnace, C a movable cross iron bar to which the upper electrodes can be clamped to hold them in position, F a double fireclay semi-circular crucible or furnace cover.

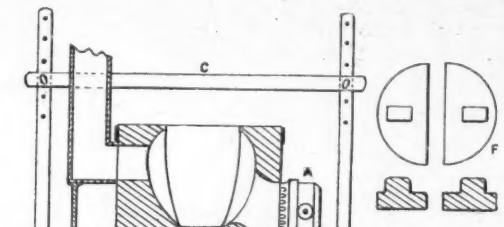

FIG. 9.

(*To be continued.*)

THE ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES IN 1899.

BY JOHN B. C. KERSHAW, F.I.C.

(*Concluded from page* 41.)

OZONE.

THE progress in the utilisation of ozone upon a commercial basis is slow, and there is little advancement to report since the date of the last annual review.

The Ozone Oil Refineries and Industries, Limited, to which reference was made a year ago, has not been floated during 1899, and the writer has been informed that the delay is due to the inability to raise the necessary capital, without heavy underwriting charges. This company was promoted by the Commercial Ozone Syndicate for operation of their patents relating to the refining of oils by means of ozonised air. Work at the experimental works in Lambeth is now confined to the production of a patent medicine, "Lozone," and to experiments upon the use of ozonised air for bleaching rhea fibre. Good results have been obtained, and developments are expected to follow from these applications of ozone.

The numerous trials of ozonised air for the purification of potable waters still continue, but the writer is unable to point to any installation which is yet working on a commercial basis. In most cases the installations are experimental in character, and are run by the inventors, or by other interested parties.

It is true that in America the Electric Refining and Purifying Company has been formed with a capital of £208,000, to erect and operate works for the purification of the water supply of Philadelphia by Ozone. In view of the absence of any details of preliminary trials, one may, however, be excused for regarding this as a scheme for extracting money from the general public, rather than as a serious attempt to test the economic possibilities of this new method of water purification.

There are no new facts or details to report concerning the trials of Ozone for water utilisation at Blankenberg, in Belgium, at Oudshorn, in Holland, or at Paris. An "Ozone Water Works" is, however, said to have been erected at Charlottenburg, in Germany, and the cost of treatment is stated to work out to ·043d. per cubic metre.*

Messrs. Marmier and Abraham have reported during 1899 upon the bacteriological results of the trials with ozonised air at Lille.† The Ozoniser used was of the Bertolus type, the E.M.F. employed was 30,000 volts, and all the germs, with the exception of "bacillus subtilis," were destroyed.

Blondin, in a more recent article,‡ gives fuller details of these trials, and states that this system of water purification has been adopted by the municipality of the town. The actual cost per 1,000 gallons, or per cubic metre of water, is not stated, and one cannot compare the efficiency of this system with that in use at Charlottenburg.

Andreoli still continues his small scale experiments in London upon the purification of Thames water, and has published notes giving the results obtained with his latest form of Ozoniser.§ In the first he stated that 140 watt-hours would provide sufficient Ozone to sterilise 1 cubic metre (35 cubic feet) water, and that probably 100 watt-hours would suffice for water taken higher up the river. In the second note he states that improvements in his apparatus have enabled him to sterilise 1 cubic metre with an expenditure of electrical energy = 70 watt-hours.

Taking the E.H P.-hour at 1½d., this equals a cost of ·14d. per cubic metre, a cost considerably higher than that given for the trials at Charlottenburg.

With regard to the use of Ozone for bleaching fabrics, there is nothing new to report. The only works known to be using Ozone for this purpose is in Germany, and here it is used in conjunction with hypochlorites, in order to obtain the degree of whiteness generally obtained by "grassing."

It is interesting to note that on May 2nd, 1899, Mr. Akers Douglas was questioned in Parliament upon the possibility of using "Ozonisers" for purifying the atmosphere of the House of Commons. The cost of the necessary apparatus was given as the reason for the non-adoption of this method of killing "influenza" germs.

In conclusion, reference may be made to a new method of producing Ozone, described by Moissan in a recent contribution to the Academie des Sciences.‖

Fluorine gas is produced by electrolysis of a fluoride, as previously described by this noted investigator, and is passed into water at 0° C.

A gas containing 14·39 per cent. Ozone by volume, and quite free from nitrogen compounds, can be obtained, and it is possible that this method of Ozone production may become of industrial importance.

ZINC.

The past year has not been signalised by the advent of any new process for the electrolytic extraction of zinc from its ores, but some progress has been made with the development of three of the existing processes.

The Hoepfner process, which depends upon the electrolysis of an aqueous solution of mixed chlorides, in a cell containing a diaphragm, is being operated at Winnington, in Cheshire, and at Weidenaau and Homburg, in Germany. Works are nearly completed for operation of this process at Hruschau, in Austria, and similar works are planned for erection in Belgium, Italy, France, and Canada. The plant at Fuerfurth, in Germany, where this process was originally worked, has been stopped during 1899; but the developments which are occurring in connection with this process in other places make it evident that this stoppage is due to local, and not general causes.

The success of the Hoepfner process is largely due to the fact that chlorine is produced as a bye-product at the anode, and that therefore the total cost of the electrical energy and of the operating charges, can be divided between the bleaching powder, in which form this chlorine finds a ready sale, and the zinc.

The Swinburne process, to which reference was made in the last annual report, is still undergoing experimental trials in London, and certain modifications in the process and cell have been found necessary as a result of this experimental

* *Centralblatt f. Bakt.* Vol. 26, 1.
† *Comptes Rendus*, May 24th, 1899.
‡ *Eclair. Electrique*, July 29th, 1899.
§ ELECTRICAL REVIEW, May 5th and June 9.h, 1899.
‖ *Comptes Rendus*, October 16th, 1899.

work. The inventor is still confident that this process will be found to solve the problem of the profitable treatment of complex sulphide ores.

With reference to the Cowper-Coles zinc extraction process, the inventor has stated in this paper* that the works at Hayle, in Cornwall, were to be removed to near London, but the writer has not heard that the process is yet at work upon a strictly commercial basis.

The trials which were made by the British Broken Hill Proprietary Company with the process in 1898, did not yield the expected results, and this company has not adopted the process for treatment of its complex ores.

The Dieffenbach process, which was worked for some years at Duisburg, in Germany, has ceased to be operated there during the past year, and Borchers has stated that the process has failed. The works at Duisburg are reported to have been bought by capitalists interested in the Hoepfner process of zinc extraction.

The Nahnsen process is still in use at Lipine, in Silesia, but it is used for refining the spelter produced at this works, and not as an extraction process.

This review of progress in the electrolytic zinc industry would be incomplete without some reference to the "Fry" process, although electricity plays only a secondary part in the extraction of zinc from its ores by this process. The report presented to the shareholders at the first annual meeting of the Smelting Corporation states that one-third of the large works at Ellesmere Port, on the Manchester Ship Canal, is now completed, and in operation. The results obtained have quite equalled expectations, and the extension of the plant to the capacity originally planned is now being rapidly carried out.† The total outlay upon this works will amount to £250,000, and its full capacity will be 700 tons complex sulphide ores per week. For the information of those readers who failed to see the note upon the Fry process in the issue of this paper for December 16th, 1898, it may be stated that the process is a metallurgical one, and comprises three operations. The ore is first roasted; it is then smelted in a cupola furnace, with the admixture of definite proportions of ferric oxide and sodium sulphate; and the slag from the smelting operation is then treated for recovery of the zinc as zinc oxide in a Siemens furnace. The first operation removes the sulphur; the second separates the silver and lead; and the third separates the zinc. It is intended that metallic zinc shall be ultimately obtained from the zinc oxide by electrolysis; but this portion of the process has not yet been worked upon a practical scale.

There are thus two processes for the treatment of complex sulphide ores in actual operation, and two others in the experimental stage of their development. In view of the repeated failures to solve the problem of the successful recovery of the silver, zinc, and lead from these ores, the progress made in recent years is eminently satisfactory.

With regard to "electro-galvanising," there is little that is new to report. The only new electro-galvanising works of which the writer has any record is one in New York, where a plant with a capacity of 2 tons zinc per day is said to have been erected. A similar works has been in operation at Pittsburg since 1898, the Duquesne process being used at this place.

CONCLUSION.

The industries dealt with above do not exhaust the list of those in which electricity is now being utilised to bring about separations formerly carried out entirely by chemical or metallurgical methods of work. Thus the production of the metals sodium, potassium, magnesium, nickel, tin, silver, and gold is now wholly or partially effected by means of electrolysis of their salts, either in aqueous solution or in a state of fusion; and phosphorus is also produced by an electro-metallurgical process.

With regard to the aggregate power now being used in the electro-chemical and electro-metallurgical industries, Dr. Borchers has during 1899 presented to the German Electro-Chemical Society figures which are startling in their magnitude. He estimates that 418,000 H.P. (378,000 H.P. water and 40,000 H.P. steam) will shortly be utilised in these industries. A detailed table taken from Dr. Borchers' paper showing how the different countries contribute to this aggregate will be found in the issue of this paper for October 20th, 1899.

The present writer has not in his possession the necessary data for checking the *whole* of Dr. Borchers' estimates, but in four of the industries dealt with in this annual review fairly reliable figures are available, and from these the figures given in the following table have been compiled:—

POWER AVAILABLE IN 1900 FOR THE ALUMIMIUM, COPPER, ALKALI, BLEACH, AND CHLORATE INDUSTRIES.

Product.	Horse-power available.		
	Water.	Steam.	Total.
Aluminium...	26,000	...	26,000
Copper	(?)	(?)	15,000*
Alkalies and bleach ...	25,600	17,000	42,600
Chlorate	32,100	3,300	35,400
Totals	83,700	20,300	119,000

* Calculated from an estimated annual output of 200,000 tons refined copper.

No *reliable figures* for the amount of power now being used in the calcium carbide, miscellaneous, and zinc extraction industries are to be obtained, and the difficulty of forming an estimate is increased by the fact already noted, that many of the producing companies are manufacturing more than one product, and devote most of their available power to that which, at the moment, yields the greatest profit. Adding, however, 85,000 H.P. to the total given in the above table for the industries omitted from it, we obtain a grand aggregate of 204,000 H.P. as the total power which is likely to be utilised in the year 1900 in the electro-chemical and electro-metallurgical industries. That this total will be increased in the near future is, however, certain.

The works already planned in Europe and America, of which some details have been already given in this review, will add about 50,000 H.P. to the total given above, and thus the estimate given by Dr. Borchers may be approached in the years 1903 or 1904.

In the year 1889, the only application of electricity in the chemical or metallurgical industries was in copper refining. At that date the output of electrolytic copper was only about 20,000 tons per annum, and the total power utilised was probably not more than 2,000 H.P.

When one compares with this even the more moderate estimate of the power that will be utilised in this new branch of electrical science in the year 1900, one is forced to admit that the progress made during the last decade of the century has been striking, and one is tempted to prophesy concerning the developments that may be expected in the coming twentieth century.

However, it is wiser to remember the old saw, "Never prophesy unless you know," and to close this article by remarking that the English electrical engineering industry has not shared, as it ought to have shared, in the developments of the past decade. The writer hopes that a greater readiness to believe in the future of these industries and to assist in their development may be witnessed during the next 10 years, and that the majority of the new undertakings which are launched may not be left entirely to German initiative, or to German electrical engineering firms for the supply of the necessary plant and machinery.

P.S.—With reference to the remarks upon the Greenwood electrolytic alkali process appearing in the issue of the ELECTRICAL REVIEW for January 5th, the writer has been informed by Mr. James Greenwood that the trials of his process at Winsford were stopped by himself "owing to the failure of the Salt Union to complete the purchase under the terms of the agreement," and that the technical adviser of the Salt Union strongly recommended them to secure the process.

Dowsing Treatment.—There has just been opened at Bournemouth a Dowsing Radiant Heat and Light Institute for the treatment of persons suffering from nervous and other diseases.

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* ELECTRICAL REVIEW, July 21st, 1899.
† The *Times* December 23rd, 1899.

Belgium, at Oudshorn, in Holland, or at Paris. An "Ozone

ELECTRICAL REVIEW, May 5th and June 9th, 1899.
Comptes Rendus, October 16th, 1899.

RECENT PAPERS ON THE COMMUTATION OF THE DIRECT CURRENT DYNAMO.

THORBURN REID.—"Sparking, its Cause and Effects": read at the meeting of the American Institute of Electrical Engineers, December 15th, 1897.
T. FISCHER HINNEN.—"Observations of Methods of avoiding Sparking in Continuous Current Machines." *Elektrotechnische Zeitschrift*, December 30th, 1897.
EUSTACE THOMAS.—"Sparking in Dynamos." The *Electrician*, February 18th, 1898.
H. N. ALLEN.—"Sparkless Reversal in Dynamos." *Journal of the Institution of Electrical Engineers*, April, 1888.
W. H. EVERETT and A. H. PEAKE.—"Experiments on Commutation in Dynamos and Motors." The *Electrician*, April 22nd, 1898.
W. H. EVERETT and A. H. PEAKE.—"The Effect of Commutation on the Field of Dynamos and Motors." The *Electrician*, December 30th, 1898.
E. ARNOLD.— *Elektrotechnische Zeitschrift*.
G. KAPP.— *Elecktrotechnische Zeitschrift*, 1899.

(*Continued from page* 45.)

§ 10.—Thus far we have only discussed the case when the conditions are those of perfect collection, and a distribution of the magnetic field has been ascertained which will prevent any difference of potential arising between the two terminal bars of a coil when under the brush. Consider now what happens when the distribution of the field is not such as to secure perfect collection.

In figs. 1 and 11, using the same symbols as before :

$2C$ is the total armature current.
R is the resistance of the coil A.
ρ is the resistance of each armature connection.
r_1, r_2 are the resistances of the surfaces of the bars 1, 2 in contact with the brushes, and are assumed to be inversely to be proportional to the areas.
r is the total resistance of the contact surface, *i.e.*, of r_1 and r_2 in parallel, so that $r = \frac{r_1 r_2}{r_1 + r_2}$.

Then R, ρ, r are constants while the values of r_1 r_2 vary continuously during commutation. Suppose that at any instant during the commutation period the rate at which the flux from the fixed field through the coil A should be diminishing in order to produce perfect commutation is F, but that as a matter of fact it is diminishing at the rate $F - f$. It is proposed to ascertain the effect of this quantity f, which may be called the field error. It produces imperfect collection by producing some difference of potential between the commutator bars 1 and 2, and it may be observed that in fig. 2 the direction of the flux F to be withdrawn from A during commutation is such that if f is positive, the potential of the bar 2 will exceed that of bar 1. Let us call this difference of potential e, so that e and f have the same sign, and if $f = o$, $e = o$.

Next suppose that at some instant the current in the coil under commutation would have the value c if the collection were perfect, but that as a matter of fact its value is $c + \gamma$, so that if $f = o$, and the collection is perfect, $\gamma = o$ also. Moreover, γ and f have the same sign.

Calling the currents flowing into the two commutator bars, as before, c_1 and c_2, $c_1 = C + c + \gamma$, and $c_2 = C - c - \gamma$.

Where V is the potential of the body of the brush, the potential of bar 1 is $V - c_1 r_1$, and of bar 2, $V - c_2 r_2$.

Then e, the excess of the potential of 2 over that of 1 is

$$c_1 r_1 - c_2 r_2,$$

i.e.,
$$e = C(r_1 - r_2) + c(r_1 + r_2) + \gamma(r_1 + r_2),$$

When $f = o$ and the commutation is perfect $e = o$, and we have $C(r_1 - r_2) + c(r_1 + r_2) = o$: so

$$e = \gamma(r_1 + r_2).$$

Hence γ the excess current in the commutated coil, caused by an error in the field, may be looked on as due to the difference of potential between the commutator bars, acting through the resistance of the contact surface; and continuous observation of this potential difference during commutation would give a complete account of the character of the collection.

§ 11. Let H be the rate at which heat is developed at the contact surface.

Then

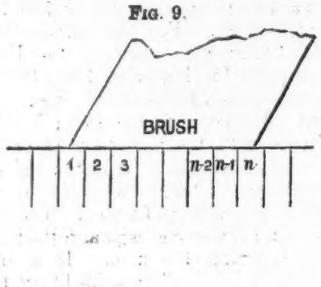
$$H = c_1^2 r_1 + r_2^2 r_2,$$
$$= (c_1 + c_2)^2 \frac{r_1 r_2}{r_1 + r_2} + \frac{(r_1 r_1 - r_2 r_2)^2}{r_1 + r_2},$$
$$= 4C^2 r + \frac{e^2}{r_1 + r_2} = 4C^2 r + (r_1 + r_2)\gamma^2 = 4C^2 r + e\gamma.$$
$$= r\left(4C^2 + \frac{e^2}{r_1 r_2}\right).$$

This expression consists of two parts. The first part $4C^2 r$ is the heat produced by the passage of the total armature current into the commutator when evenly distributed over the contact surface, and is the total rate at which heat is developed when the collection is perfect. It is determined by the output of the machine and the construction of the commutator and brushes. It cannot be reduced by any adjustment of the field, or of the position of the brushes.

The second part is the result of imperfect commutation, and is essentially positive. The values of e and γ may be reduced to zero by proper arrangement of the field, near the commutation point and to do this is the problem of dynamo commutation. The importance of the term may clearly be reduced by increasing the values of r_1 and r_2, *i.e.*, of the resistance of the contact surface : but this involves a corresponding increase in the first term.

§ 12.—The form of these last expressions is not peculiar to the particular case when the brush is of the width of one

FIG. 9.



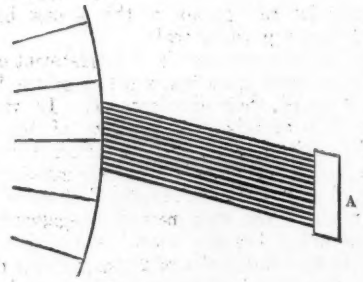


FIG. 10.

commutator bar. Thus if in fig. 9 the brush touches n commutator bars, suppose a_1 a_2 a_3 . . . . a_n to be the contact areas of the several bars, v_1 v_2 v_3 . . . . v_n the potential differences between the brush and the several bars, and q the conductivity of the contact surface per unit of area. Then the currents flowing into the several bars are $v_1 a_1 q$, $v_2 a_2 q$, $v_3 a_3 q$ . . . . $v_n a_n q$. Heat is developed at the several surfaces at the rates $v_1^2 a_1 q_1$, $v_2^2 a_2 q_2$ $v_2^2 a_3 q$ . . . . $v_n^2 a_n q$.

The total armature current $2C = \Sigma v a q$.

Heat is developed at the rate $\Sigma v^2 a q = H$ say.

The conductivity of the total contact area $= \Sigma a \gamma = \frac{1}{r}$ say.

Then since $\Sigma v^2 a \times \Sigma a = (\Sigma v a)^2 + \Sigma a_1 a_2 (v_1 - v_2)^2$ the last expression having $\frac{1}{2} n (n-1)$ terms.

Multiplying all terms by q^2 we have

$$H = 4C^2 r + r \Sigma \frac{(v_1 - v_2)^2}{r_1 r_2}.$$

This is identical in form with the last expression for H in § 11, in the case when $n = 2$.

* Electrical Review, July 21st, 1899.
† The *Times* December 23rd, 1899.

for the treatment of persons suffering from nervous and other diseases.

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§ 13.—The form of these expressions does not show the effect on the value of H of changing the contact surface resistance (*e.g.*, by a change of the material of the brushes). An increase of the surface resistance will increase the value of the first term $4\,C^2\,r$ in the same proportion, and in all cases where the commutation is good, and the second term is small, the brush surface resistance should certainly be as small as possible. But the effect of a change on the second term is not apparent, and it is desirable to ascertain whether an increase in the value of r may not in some circumstances reduce the value of this second term to an extent which will more than compensate for the increase in the first term.

We may consider the distribution of the flow of current from the brush into the commutator as the result of superposing a local current (the current that has been called γ) circulating in the dotted circuit of fig. 11 on the uniform distribution of flow which it is desired to secure, and is obtained in perfect commutation. The electromotive force acting in this circuit is due to an excess or deficiency in the rate at which the flux is being increased in the coil, and the resistance of this circuit consists of the sum of the resistances of the coil itself, of the two connections marked ρ, and of the two brush contact surfaces; and the local current may be reduced by increasing the resistance ρ of the connections. This increase would of course be also inserted in the path of the main armature current, but whereas the connections would be in parallel in the main circuit, they would be in series in the local or dotted circuit, and the resistance introduced by them might improve the collection to an extent which would justify the consequent fall of potential in the main circuit. Moreover, these connections are idle during all but a small part of the revolution, and may be of small size.

Another mode of inserting resistance into the dotted circuit is to construct the brushes of laminæ having appreciable resistance as in fig. 10. These laminæ insulated from one another along their length are soldered into a solid piece marked A into which the current is introduced. This arrangement inserts a resistance between A and each commutator bar inversely proportional to its contact area, and its action on the value of e or γ is the same as if the contact surface resistance were increased by the same amount. It has, however, the considerable advantage that the extra heat is developed in the body of the brush instead of on the commutator surface, and if the advantage of carbon over copper brushes lay solely in the greater resistance of their contact surfaces, it is probable that a laminated brush would be preferred to a carbon one.

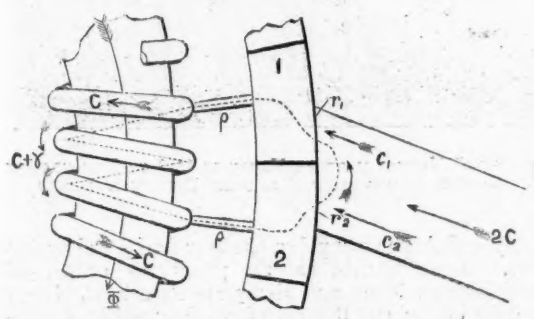


Fig. 11.

§ 14.—To ascertain the effect of these resistances on the values of e and γ, and the heat developed at the brush, consider the electromotive force acting in the dotted circuit of fig. 11. The flux in the circuit in the direction of the large arrow, marked Φ, is decreasing at a rate

$$(\text{F} - f) + n\,l\,\frac{d}{d\,t}\,(e + \gamma)$$

where n is the number of turns in each armature section, and l the inductance of each. R is the resistance of each turn in the coil, ρ of each connection, r_1 r_2 the resistances of the commutator surfaces. C, e, γ, c_1, c_2, have the meanings of § 10.

Then $$-\,n\,(\text{F} - f) - n^2\,l\,\frac{d}{d\,t}\,(e + \gamma)$$
$$= n\,\text{R}\,(e + \gamma) + r_1\,(r_1 + \rho) - c_2\,(r_2 + \rho)$$
$$= \text{C}\,(r_1 - r_2) + e\,(r_1 + r_2) + e\,(n\,\text{R} + 2\,\rho) + \gamma\,(n\,\text{R} + 2\,\rho + r_1 + r_2).$$

In § 10 it was shown that $\text{C}\,(r_1 - r_2) + e\,(r_1 + r_2) = e$, and when $f = e$, $\gamma = e$.

Hence the last equation may be resolved into the two

$$-\,n\,\text{F} - n^2\,l\,\frac{d\,e}{d\,t} = (n\,\text{R} + 2\,\rho)\,e$$

$$n\,f - n^2\,l\,\frac{d\,\gamma}{d\,t} = (n\,\text{R} + 2\,\rho + r_1 + r_2)\,\gamma$$

From this last equation the value of γ, and the consequent sparking, may be ascertained for any given error, f, in the commutation field.

Now, r_1 r_2 vary with the position of the commutator bars under the brush. Counting the times from the middle of the commutation period, a period we will call 2 T, the commutation begins when $t = -\text{T}$, when $r_1 = r$ and $r_2 = \infty$; and ends when $t = +\text{T}$, when $r_1 = \infty$, and $r_2 = r$.

At any intermediate time T, $r_1 = \dfrac{2\,\text{T}}{\text{T} - t}\,r$, and $r_2 = \dfrac{2\,\text{T}}{\text{T} + t}\,r$.

The differential equation in γ now becomes

$$n^2\,l\,\frac{d\,\gamma}{d\,t} + \left(n\,\text{R} + 2\,\rho + \frac{4\,\text{T}^2}{\text{T}^2 - t^2}\,r\right)\gamma = n\,f,$$

which may be written $\dfrac{d\,\gamma}{d\,x} + \left(a + \dfrac{2\,b}{1 - x^2}\right)\gamma = g,$

where $a = \dfrac{n\,\text{R} + 2\,\rho}{n^2}\,\dfrac{\text{T}}{l}$, $b = \dfrac{2\,r}{n^2}\,\dfrac{\text{T}}{l}$, $g = \dfrac{f}{n}\,\dfrac{\text{T}}{l}$,

and $x = \dfrac{t}{\text{T}}$.

The general solution of the last equation is

$$\gamma\,\phi\,(x) = \text{A} + \int g\,\phi\,(x)\,d\,x, \text{ where } \phi\,(x) = \varepsilon^{a\,x}\left(\frac{1 + x}{1 - x}\right)^b,$$

and in the case of dynamo commutation we are considering $\gamma = e$ when $x = -1$, so that $\text{A} = e$ and the solution becomes

$$\gamma = \{\phi\,(x)\}^{-1}\int_{-1}^{x} g\,\phi\,(x)\,d\,x.$$

It may be noted that γ is independent of C.

The expression $\int g\,\phi\,(x)\,d\,x$, is not generally integrable, even when g is independent of x, but may be evaluated numerically for any particular case.

§ 15.—To illustrate the character of the solution the example of § 8 may be employed, in which the following constants were assumed:

2 C, the total armature current, is 200 amperes = 20 units, *i.e.*, C = 10 units.

There are two convolutions to each armature section, *i.e.*, $n = 2$.

The resistance of each armature section is ·0001 ohm, and of each turn, ·00005; *i.e.*, $\text{R} = 5 \cdot 10^4$ units.

The commutation period is ·002 second; *i.e.*, $\text{T} = 10^{-3}$ second.

Since two turns of a current of 10 units produce 100,000 lines of magnetic flux. The inductance of one turn is 5,000; *i.e.*, $l = 5 \cdot 10^3$ units.

The brush contact area is 25 sq. cms., with a resistance of ·025 ohm per sq. cm.; *i.e.*, $r = \cdot001$ ohm $= 10^6$.

In the present case no armature connections are used, and $\rho = e$. The effect of giving appreciable values to ρ will be considered presently.

(*To be continued.*)

SANDING OF TRAMWAY TRACKS.

Judicial decisions frequently inform the general public that behind the austere countenance of the bewigged judge there lurks an intelligence of a very ordinary type. We certainly cannot envy Mr. Swifte, of the Southern Police

Court of Dublin, in the matter of his intelligent rendering of a very simple clause when he inflicted a fine on the Dublin United Tramways Company for not sanding their paved track. Clause 37 of the Company's Act, which he had to construe, reads as follows:—"The company shall at all times maintain and keep in good condition and repair, and so as not to be a danger or annoyance to the ordinary traffic, the rails of the tramways and the sub-structure upon which the same rests, and also the paving wires, posts, tubes, and electrical apparatus of any description whatever." It seems to us as plain as possible that this clause has special reference to the maintenance of the rails at the level of the road surface and the maintenance of the paving free from hollows. How any intelligent man can possibly twist this clause to include sanding, passes all comprehension. We doubt if any but a legal mind could so twist this clause as to make it demand sanding. As we have before said, the paving of a tramway track is done for the purpose of withstanding the abnormal wear and tear of horse-shoes, and this abnormal wear was sufficiently marked and severe to render it necessary that even on a macadamised road the track of a tramway should be paved. Where the paving falls below the rail level, there is great danger to wheels crossing the line at a flat angle, it is only right that high rails should be guarded against, and it is against the danger of such high rails that Clause 37 of the Dublin Company's Act is levelled. We cannot see that the clause contains words of doubtful import, which must therefore be construed against the covenanting party, namely, the tramways company. Mr. Gordon contended, and very properly, that so long as the paving was maintained in order structurally, there was no obligation to maintain its surface in a condition to be run upon by the public, so far as the surface was affected by weather. We presume that the laying down of the tramway has not altered the superficial area of the street, and the only user of the tramway track is the public; the tramway itself uses only the rails, not the paved surface, and obviously a common sense view is that, as the public uses the track and the company does nothing to render that track more unsafe to run upon than the other portions of the street surface, therefore the public should provide sand in case of, say, frost or other interfering cause. Seeing the kind of construction put on simple clauses, as witness the present case, and the unfortunate purchase clause in the Act of 1870, it is much to be hoped that every care will be taken to have such unjust and unfair clauses provided against in the Bill which cannot long be delayed. Unless something be done to put a stop to the unreasonable demands of local authorities and the ridiculous construction placed upon clauses of Acts by legal luminaries, a great check will be put upon the progress of industrial undertakings.

JOSEPH HENRY.*

By CUYLER REYNOLDS.

(*Concluded from page* 79.)

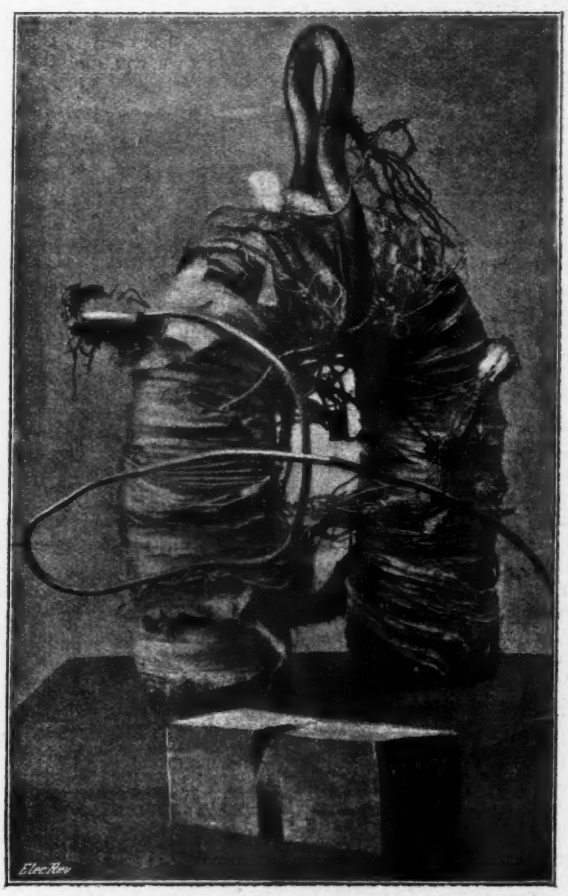
Morse's telegraphic apparatus lacked the powerful magnets that Henry invented. It was shown in court that his invention, embracing his system, would have failed had not Henry's invention in this line helped him to surmount the difficulty. Morse, having worked out a practical telegraphic system, has been given credit in the popular mind for the whole, but the work accomplished by Henry made it possible for Morse to render his system practicable. In spite of the rivalry between the two inventors, and all that was said at the time in disputing the claims of priority for the two by their supporters, Henry brightened Morse's darkest hours, between 1839 and 1843, by encouraging him, which goes to prove that Henry was satisfied with discovery, and was only too glad that others might benefit pecuniarily. The letter that Henry wrote to Morse refers to a prospective test of the latter's invention in practice by a line of 40 miles, connecting Baltimore with Washington:

"Princeton College, *February 24th*, 1842.

"My Dear Sir: I am pleased to learn that you have again petitioned Congress in reference to your telegraph; and I most sincerely hope you will succeed in convincing our Representatives of the importance of the invention. . . Science is now fully ripe for this application, and I have not the least doubt, if proper means be afforded, of the perfect success of the invention. With my best wishes for your success, I remain with much esteem, Yours truly,

"Joseph Henry."

In December, 1842, the sum of $30,000 was appropriated, passing the House of Representatives on February 23rd, 1843, and the Senate on March 3rd. The four wires were extended, and on May 24th, 1844, the first message was sent. The success led to many inventions all over the country, and they to many lawsuits brought by and against Morse. These brought out the priority of claims, and rivalry between Morse and Henry was engendered. Henry was defended by the Regents of the Smithsonian Institution, who certified to the priority of Henry's researches and indorsed his claims, which were:—



"Intensity" Magnet made by Henry in 1829 to Demonstrate Telegraphic Transmission, Princeton University Museum.

1. Previous to my investigations, the means of developing magnetism in soft iron were imperfectly understood, and the electro-magnet which then existed was inapplicable to the transmission of power to a distance. 2. I was the first to prove by actual experiment that in order to develop magnetic power at a distance, a galvanic battery of intensity must be employed to project the current through the long conductor, and that a magnet surrounded by many turns of one long wire may be used to receive the current. 3. I was the first actually to magnetise a piece of iron at a distance, and to call attention to the fact of the applicability of my experiments to the telegraph. 4. I was the first to actually sound a bell at a distance by means of the electro-magnet. 5. The principles I had developed were applied by Dr. Gale to render Morse's machine effective at a distance. The results here given were among my earliest experiments, in a scientific point of view considered then of much less importance than what I subsequently accomplished; and had I not been called upon to give my testimony in regard to them, I would have suffered them to remain without calling public

* *Scientific American.*

attention to them, a part of the history of science to be judged of by scientific men, who are the best qualified to pronounce upon their merits.—Smithsonian Report for 1857.

It was Henry who explained the difference between "intensity" and "quantity" to Morse, and L. D. Gale testified that he saw the imperfection in Morse's work and advised him that—

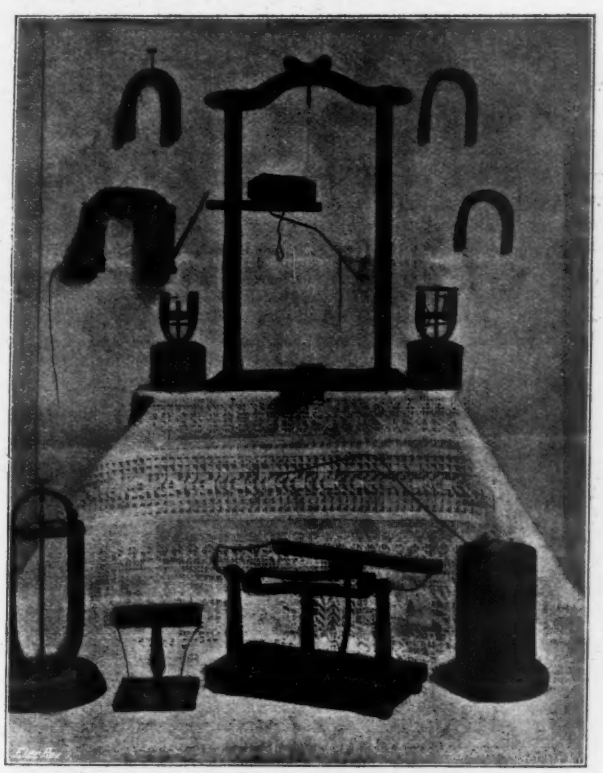
The sparseness of the wires in the magnet coils and the use of the single cup battery were to me, on the first look at the instrument, obvious marks of defect, and I accordingly suggested to the professor, without giving my reasons for so doing, that a battery of many pairs should be substituted for that of a single pair, and that the coil on each arm of the magnet should be increased to many hundred turns each; which experiment, if I remember aright, was made on the same day with a battery and wire on hand, furnished, I believe, by myself, and it was found that while the original arrangement would only send the electric current through a few feet of wire, say, 15 to 40, the modified arrangement would send it through as many hundred. Although I gave no reasons at the time to Prof. Morse for the suggestions I had proposed in modifying the arrangement of the machine, I did so afterward, and referred in my explanation to the paper of Prof. Henry in the 19th volume of the *American Journal of Science*, page 400 and onward. . . . . At the same time I gave the suggestions above named, Prof. Morse was not familiar with the then existing state of the science of electro-magnetism. Had he been so, or had he read and appreciated the paper of Henry, the suggestions made by me would naturally have occurred to his mind as they did to my own. . . . . Prof. Morse professed great surprise at the contents of the paper when I showed it to him.

much thought in solving the wonderful problem came from the former, the doctor friend never uttered any detraction from the fame of Henry. The participation of Ten Eyck was so prominent and is made to appear so authentic from many sources that the two names must continue to be interwoven in the telling of what was done. Dr. Ten Eyck was selected to take Prof. Henry's place when he resigned in November, 1832, to accept the Professorship of Natural Philosophy in the College of New Jersey at Princeton.

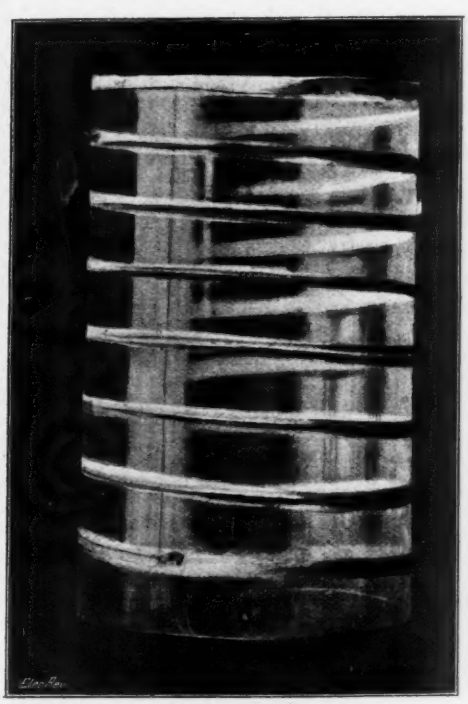
In 1837 Prof. Henry visited Europe, the object of this trip, as stated in his own words, being: 1. The formation of personal acquaintance with men of science, which may be the basis of future correspondence on scientific subjects. 2. The study of the modes of instruction in science. 3. The methods of making original researches in the different branches of science. In short, to make such attainments as may be useful either in the way of my duties as an instructor or in reference to my own researches, and which cannot be obtained from books.

As I feel considerable strength on some subjects of science, I shall not be ashamed to show my ignorance on others by asking questions even of an elementary nature.

While in Europe he had many delightful interviews with Faraday, profitable and pleasurable conversations to both. With Wheatstone, who was then Professor of Experimental Philosophy in King's College, he talked of magnetic circuits. In Paris he met Gay-Lussac, Arago, Biot, Becquerel, and



Magnetic Apparatus made by Henry, now in the Smithsonian Institution.



Jar, with Tinfoil Spiral, used by Henry to Prove the Induction of the Static Discharge, Princeton Museum.

There is no question regarding the serious handicap placed on Henry's labours through lack of funds. This did not so much affect the needful purchases for science, which were however, a tax; but cramped the time which he could devote to research. In both ways the remedy was advantageously found in one who was his most intimate friend during the time that he was working in the Albany Academy. This man was Dr. Philip Ten Eyck. The friend relieved Henry of the labour of making many of the parts of the now famous telegraph machine, supplying them from his own purse and contributing to Henry's curtailed time by working in the basement while Henry attended to his classes on the main floor above. So indefatigable was Dr. Ten Eyck in collaboration with Henry that it would be negligence whenever speaking of the work of those days and the invention of the telegraph to omit his name: and though

De la Rive, and on his travels Dr. A. Dallas Bache (died 1867) proved a valued companion. Dr. Bache's father, Richard, was a son of the only daughter of Benjamin Franklin. At Paris Henry was unable to speak the language, but he met there, studying medicine in the Latin Quarter, Thomas Hun, M.D., of Albany (1808—June 3rd, 1896), whom he knew well at the Academy, and he acted as an interpreter. To this day it is quoted that Hun, although a prominent physician, was proud to style himself "Mouthpiece of his Majesty."

Henry was ever weighing his moments, that he might yield the greatest profit to science. Strangely indeed, while he knew he had remarkable ability, it cannot be pointed out that he ever so declared himself vauntingly.

He was obliged to earn a livelihood, and this he considered as a millstone. It was, during the early years of his life,

like so much work before play, his play being deeper work than ever. When new positions were offered to him, he did not think what advancement in fame attached to them or what the financial gain might be, but only how much time he would have for his precious researches after he had each day fulfilled the quota of work to supply the body with food. If the new position might place him in ease, yet rob him of hours for scientific study, he could not see how he should better himself by accepting the offer.

Even at so youthful an age as that of his election to fill the Chair of Natural Philosophy at Princeton (November, 1832, aged 35), he was regarded as the leading man of science in America. Prof. Benjamin Silliman, of Yale, in urging his appointment, wrote: "Henry has no superior among the scientific men of the country;" and Prof. James Renwick, of Columbia, added: "He has no equal." It is needless to say his election was unanimous, and Princeton was the gainer. So varied was his learning that in 1833, while Dr. Torrey was in Europe, Prof. Henry filled his chair of chemistry, mineralogy and geology, and subsequently he lectured on astronomy and architecture.

Here he even found time to make researches in the college laboratory, constructing an original form of galvanic battery, so arranged as to bring into action any desired number of elements, from a single pair to 88.

His studies brought about discoveries in electrical self-induction, combined circuits, oscillation of electrical discharge, on "a simple method of protecting from lightning, buildings covered with metallic roofs," molecular physics, simple forms of heliostat, phosphorogenic emanation, relative heat-radiating power of solar spots, phenomena of fluorescence, electricity obtained from a small ball filled with water and heated by a lamp, new method of determining the velocity of projectiles, sonorous flames passing into a stove pipe, flow of water jets under varying conditions, relative angle of vision formed by a moving body, organic dynamics, derivation of species and affiliation of specific forms, limit of perceptibility of a direct and reflected sound, the thermal telescope, electric engine, which was the forerunner of the great principle we now enjoy so extensively in the motors of various kinds.

The Act of Congress, approved August 10th, 1846, established the Smithsonian Institution for promotion of science, employing the liberal bequest of James Smithson, of London. Henry was made its first secretary, December 3rd, 1846, and actual director. He was afraid that his duty to the Institution would prevent him from making further research as at Princeton, and he questioned whether "If I go, I shall probably exchange permanent fame for transient reputation," meaning that fame signified material gain for the scientific world. But he found the work so compatible with his ideas, that in 1847 he declined a call to the Professorship of Chemistry in the Medical Department of the University of Pennsylvania, despite the urging of his friend Dr. Robert Hare, and the salary, more than double that he was receiving at Washington.

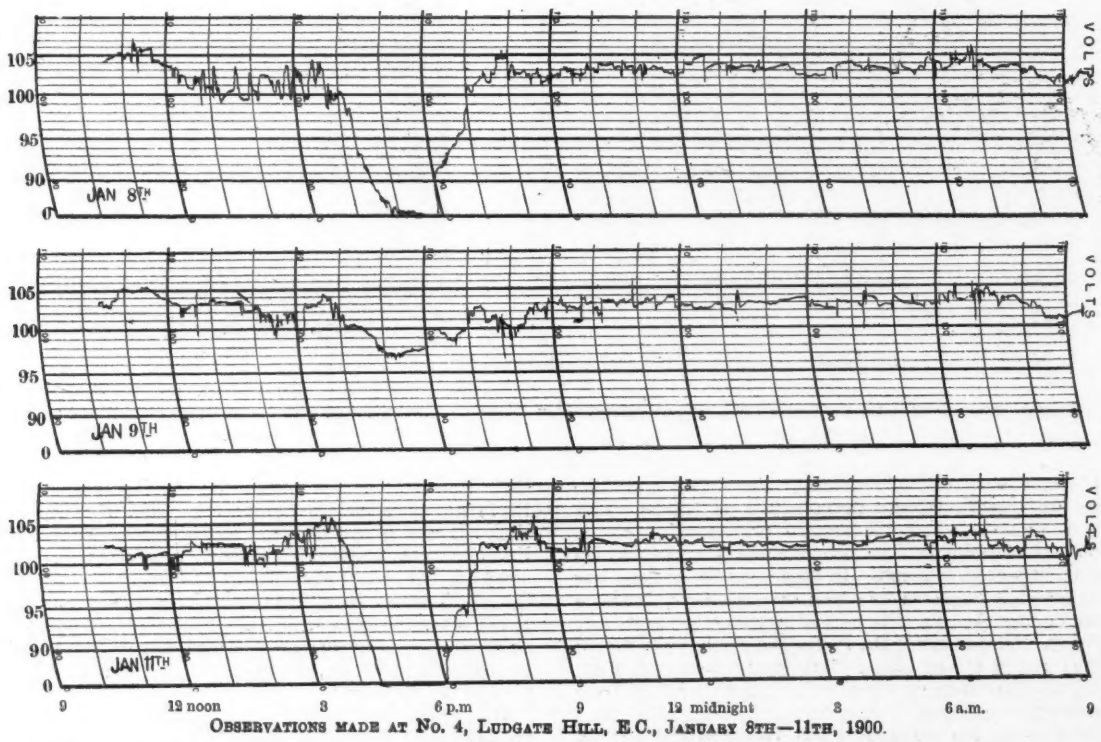
He brought his scientific service to the use of the light-house board, geological, meteorological departments, and aided in establishing observatories. How he could find the time, it is hard to say.

Late in life (1875-77) as chairman of the committee of experiments of the United States Lighthouse Board, he conducted half a hundred experiments, and some of the nature that reasonably lead one to suppose that had he continued to live a little longer, he, with his mind well furnished with electrical data, would have given us the wireless telegraph. Through his efforts he secured to the Government the free use of the Atlantic cable for transmission of important dispatches regarding astronomical discoveries, and the Royal Geographical Society passed a resolution of thanks in recognition of the good service. London also honoured him in the "freedom of the city" on his visit, and three steamship companies asked the privilege of conferring free transportation.

Joseph Henry died May 13th, 1878. Fitting memorial exercises were held in the hall of the House of Representatives. Vice-president Wheeler presiding, and addresses were given by several prominent men.

THE CITY LIGHTING.

The curves which we reproduce herewith, and refer to in our leading article this week, are records of the pressure measured at our supply terminals on the 8th, 9th, and 11th inst. They are the outcome of several recent failures of our lighting, which induced us to find out exactly what treatment we were receiving. The instrument used was a recording voltmeter, made by Messrs. Nalder Bros. & Thompson, which was fixed in the basement, and connected with a fuseboard close to the meter. The curve



Observations made at No. 4, Ludgate Hill, E.C., January 8th—11th, 1900.

for Monday, January 8th, shows a precipitous fall between 4.15 and 4.45, attaining at its worst to about 86 volts, or 14 per cent. below the normal. By 7 p.m. the pressure has recovered to its normal value, and promptly runs up to 5 per cent. above normal; for the rest of the night a very good record is shown, with practically no load on.

The curve for January 9th, which closely resembles that for January 10th, does credit to the supply undertakers; the pressure never falls below 97 volts, and rarely exceeds 104 volts. On the 11th, however, the cataract is again met with; at 4.15 down comes the pressure, and this time the voltmeter pointer goes hard over. What was the lowest depth attained is, in this case, unknown; but the pressure is far below normal for almost three hours. Since the 11th the curves have been similar to that of the 9th.

We are given to understand that the difficulty of obtaining coal is the explanation of the curious performances here illustrated; but why should this make itself felt in such an erratic manner? If on Monday, why not on Tuesday? And how have other London companies overcome or avoided the difficulty?

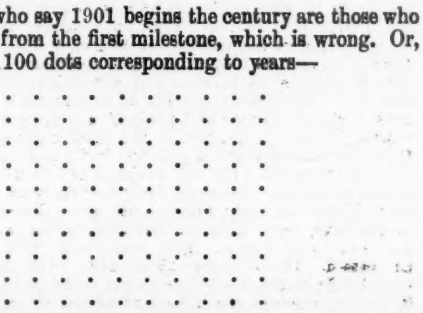
CORRESPONDENCE.

The Century Problem.

It was a famous axiom of a certain well-known judge that a reason should never be given for a judgment. You have, however, alone ventured to give reasons for January 1st, 1901, being the first day of a new century, that I feel sure you will be sufficiently generous to allow me to point out the error upon which your reasoning is based. You present a simple analogy to us by saying "When does a new week commence? On the *first* day of the new week." Now, as exactness of thought and word is necessary to a right understanding of this simple matter, it is exact to say rather that the *first day* of the new week commences at the *first second* (of which 86,400 are necessary to complete the first day), or point of time, which, when complete in 24 hours, constitutes the day 1, or first day. The calculation, therefore, proceeds from the first point or second of time, and not from the figure 1. Now apply this to the century problem in, say, two ways out of dozen or more instances.

A pedestrian contracts to run 100 miles, when he arrives at the hundredth milestone he has completed 100 miles, one step beyond it and he is *commencing* the next mile; before reaching the first milestone, however, he must run 1,760 yards.

Now, those who say 1901 begins the century are those who begin to count from the first milestone, which is wrong. Or, again, here are 100 dots corresponding to years—



Now, the first dot counts from the first second of the first day, of which 365 are needed to make the first year, and immediately the last dot, or year, is reached is signified the second of time at 12 midnight, constituting the following first second of time beginning the 86,400 necessary to complete the first day of the New Year, or century.

Or, in other words, before we can logically count one year, or speak of the first year, we must realise the *first* second of 31,536,000 seconds of time, which constitute one year of 365 days.

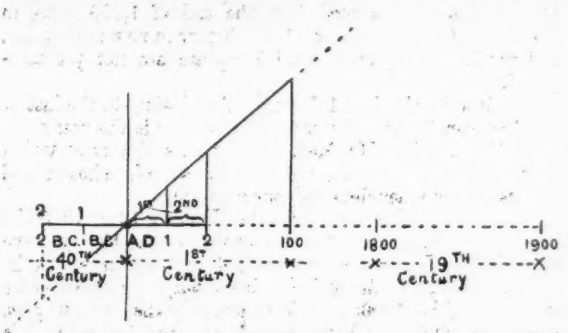
Thus all time computations of necessity, both philosophically, mathematically, and scientifically and astronomically, must be preceded by a point, dot, or nought, the essence or material parts must precede the object or unit 1, and thus Q.E.D. as up to midnight, December 31st, 1899, we speak of the nineteenth century. At one second past midnight we record a new century (1900), the first year of which is *complete* at midnight, December 31st, 1900; then follows on 01, 02, &c.

T. May.

Tottenham, *January 14th*, 1900.

Twentieth Century.

Had it not been for the unfortunate fallacy that has crept into the text in your explanation of your admirably lucid and correct diagram in your issue of January 12th, I should not have ventured to occupy the valuable space in your columns by writing this letter; but your diagram proves that the twentieth century has commenced, and your text asserts to the contrary. Undoubtedly the twentieth century *has* commenced. I feel sure you desire to maintain the accuracy of your journal, and that after further consideration you will adopt the correct and only logical interpretation of your diagram, and that you will take the lead and correct the errors into which some of our other friends of the electrical press have fallen.



After Lord Kelvin's opinion had appeared in print in agreement with Sir Courtenay Boyle's view, one had hoped that the matter was settled. Imagine one's consternation when reading your explanation, to find that the nineteenth century was to be blessed, or otherwise, with 101 years. The fact is, the whole matter turns upon the question of what we mean when we write down the date of the year. We are now using the date 1900, and by reference to your diagram we find it coincides with the end of the 1900th year, therefore 1,900 years are completed, or 19 centuries.

To test the accuracy of this, we need only refer to the first year on the scale of your diagram. Zero represents the epoch from which succeeding years are counted, and it is the commencement of the first century, also, of course, the commencement of the first year A.D. You will observe that you do not write down the date 1 till one year is completed—it would be inaccurate to do otherwise—therefore to keep in uniformity throughout this scale the date 100 cannot be written till 100 years are completed, *i.e.*, the end of the first century and the commencement of the second century; similarly the date 1900 cannot be written till 1,900 years are completed, *i.e.*, the end of the nineteenth century and the commencement of the twentieth century. It is also obvious that the dates in which 00 recur represents the closing of one century and the opening of the next.

To fix this idea, let us start from the house on a bicycle, say, with an accurate cyclometer attached set to zero, then we shall have no correct register of 1 mile until the cycle is completed, *i.e.*, on a measured course, when the No. 1 milepost is reached, similarly with 100 miles and 1,900 miles.

To return, the fact that we are now entitled to use the date 1900 means that we have completed 1,900 years, having reached, as your diagram shows, the end of the 1,900th year, while at the same time we recognise the fact that a new year is in progress by adding to the completed years the month and the day of the month.

In taking a comprehensive view of the matter it must not be forgotten that the years B.C. continually decrease till the time passes through zero, and the years A.D. increase from zero. This is illustrated by an amplification of your admirable diagram given above. Further, this view of the

matter is clearly borne out by the chronological map from the creation which is supplied in some editions of Bagster's Polyglot Bible.

W. Howard Tasker.

Kensington, *January 16th*, 1900.

[We were grieved to receive these letters; we trust that they may be the last on this matter.

In reply to Mr. May, we explained in our Note that dates are applied *not* to points but to *periods*, and we do not care about seconds or instants—the first day of the week is *in* existence directly the preceding day ceases to be, and we say, "It IS Sunday," or, "It IS the first day," whatever the hour of the day may happen to be; we do not say, "This WILL BE the first day at the stroke of midnight."

Our correspondent makes exactly the same mistake as we pointed out last week; he applies the numbers to the *partitions* between spaces of time, whereas they are the *names of the spaces between* the partitions. If he counts his 100 dots, he will say "one, two, three . . . . one hundred," and if he counted 1900, he would begin the 20th hundred with 1901.

In reply to Mr. Tasker, we agree that the matter turns upon what we mean when we write down the date of the year; our diagram most decidedly shows that the date (1900th year) holds good from the end of 1,899 years to the end of 1,900 years; the 1,900th year is now in progress, and our diagram proves that 1,900 years are not yet completed.

We *do* write the date 1 from the first instant to the last of the first year, because the name of that year is the year *one*.

Mr. Tasker, like Mr. May, again makes the error which we pointed out last week, and to which we refer above; and he has totally misunderstood our diagram.

When Mr. Tasker dates his letter January 16th, 1900, he really means (according to his own view) that 15 days have elapsed since January commenced, + a fraction which he does not state, and *the 16th day is not complete*; so when we write 1900 (the 1900th year), in precisely the same way we mean that 1899 years have elapsed, and the 1900th year is not complete. What could possibly be more simple?—EDS. ELEC. REV.]

An Explanation.

Referring to the notice made in a recent issue of your Journal of the voluntary liquidation of Messrs. Nalder Bros. and Co., Limited, late of Red Lion Street, we should be glad if you would note that this in no way affects ourselves. As is generally known we purchased, in 1896, the goodwill, plant, &c., of the ammeter, voltmeter and switchboard business carried on by that firm, and that we are the sole makers of the N.C.S. measuring instruments and switches specified above.

We regret to have to ask you to publish this letter, but we are compelled to do so owing to the fact that we have had inquiries made of us, as to whether the voluntary liquidation of Nalder Bros. & Co., Limited, would affect the contracts which we have in hand. We may say that while our relations with the above firm have always been of the most friendly character, there is absolutely no connection between us, and we shall be glad if you will kindly publish this fact.

Nalder Bros. & Thompson, Limited.
E. THOMPSON, *Managing Director*.

January 17th, 1900.

The Use of Rubber Insulated Wire in Steel Conduits.

If your correspondents had carefully read my article, they would have seen that the conclusions are not those which they assume.

Mr. Frederick Yorke quotes as follows:—"As long as wood casing only is used, we see that no inconvenience is caused by the perishing of the India-rubber," and from this he arrives at the conclusion that I advocate the use of wood casing, whereas the statement when read in connection with the context is only relative, for in the next paragraph, referring to steel conduit, he will read:—" . . . . which will, it is to be hoped, gradually abolish wood casing."

Mr. Isherwood and Mr. Butt will also find nothing which can lead them to assume that I advocate the use of "insulated pipe." On the contrary, the universal use of Simplex or other standard steel tubing is taken as an axiom, and as these conduits are only a "special case" of ordinary gas pipe, it follows that I have not modified my former opinions in the least, even on the point that gas piping requires the best wiring work only, and should never be touched by those who, like Mr. Isherwood, go on gaily slinging wire of poor insulation into "insulated pipe."

Simplex conduits, &c., are improvements on gas pipe, for reasons of economy, and in order to meet the powers of the average workman, who, instead of being an engineer in the first place, and a wireman in the second, is more often a store boy, who suddenly buds into a full-blown wire slinger, with no other thoughts than to get the wires through, as long as he has strength to pull, and to wait for 12 noon on Saturday. I have nothing to urge against the use of "insulated pipe," except that it appears to be a direct encouragement to these gentry. Its insulating qualities, taken over a whole insulation, are at present an unknown quantity, and therefore its use does not trouble the conscience. It can also hide a multitude of sins, both of commission and omission. It is because of all these things that I draw attention to the fact that vulcanised rubber is perishable, and that therefore, under the increasing conditions of 200-volt supply, it would be well if those now drawing up rules should insist on the use of high grade insulated wires only, pending the finding of a better substitute. Apologising for taking up so much of your space.

V. Zingler.

Electric Riveters.

Some form of electric riveter was used by the late American engineer, Mr. Loweth.

They were used for flume work, and for both riveting and caulking, but with what success they met I cannot say. I don't think any details were ever published, though they would be interesting.

No doubt the electrician to Mr. Loweth, Mr. N. Dafty, would be kind enough to give the correspondent full particulars of the work. Will some reader please bring this to his notice?

Rex.

LEGAL.

MESSRS. TURNER & SONS *v.* BRINSMEAD.

IN the Queen's Bench Division of the High Court of Justice on Thursday, January 11th, the action Turner *v.* Brinsmead came on for hearing before Mr. Justice Mathew, in the Commercial Court. Plaintiffs, Messrs. John Turner & Sons, of Manchester, sued the defendant, Mr. Thomas James Brinsmead, to recover £260, being the contract price for an electrical lift. Defendant counterclaimed, setting out in his defence that by an agreement of November 1st and 3rd, 1897, the plaintiff firm agreed to construct and erect upon flats then in course of construction at Maitland Park, Haverstock Hill, London, an electrical lift according to specification, the contract providing that the whole work and material should be of the best description and quality, the lift to be completed by February 1st, 1898, to the satisfaction of defendant's consulting engineer, of the St. Pancras Vestry officials, and of the insurance company's inspector. Defendant alleged that the plaintiffs had committed breaches of the contract in that they did not complete the work by the date named therein or within a reasonable time; that the work was not completed up to November, 1898; that the lift which defendant received was so defective, both in design and construction, as to be dangerous as well as useless, and was such that it could not be passed. On January 23rd, 1899, defendant gave notice to plaintiffs, calling upon them to remove the lift and fittings, but as it was not removed the defendant had it returned and employed another contractor. Defendant pleaded that by reason of plaintiffs' delay in supplying and erecting he had suffered damage and prevented from letting a number of flats, as well as having incurred expense in making compensation to the tenants of other flats which had been completed for occupation. According to the counterclaim, defendant sought to recover £4 1s. for charges by the Otis Elevator Company for dismantling plaintiffs' lift, £515 17s. for the supply by the Otis Elevator Company of a new lift, £40 builders' account for dismantling, £58 10s. allowance to the tenants, and £250 in respect of six flats unlet, a total of £868 8s., or £608 8s. after deducting the price to be paid plaintiffs for their lift as per contract.

Mr. Bousfield, Q.C., and Mr. Neill appeared for the plaintiffs, and Mr. Jelf, Q.C., and Mr. J. Eldon Banks for the defendant.

Mr. BOUSFIELD, Q.C., in his opening statement for plaintiffs, read a considerable amount of correspondence which had passed in reference to the contract between the parties to the suit, and said that on November 15th the lift was handed over to the defendant and accepted by the Vestry.

In response to a question by his Lordship, Mr. JELF, Q.C., said he thought he could shorten the case if he were allowed to put his expert witnesses in the box first. His case was that the lift was utterly unworkable; it jammed, and the arrangements were made in such a loose and unfinished manner that the slightest thing going wrong upset the whole thing, and it became absolutely impossible to work it.

Mr. BOUSFIELD said he never dreamt it would be necessary to go through the whole list of particulars which defendant had included in his statement of defence. He (Counsel) took up the broad position that a lift had been erected which met, from time to time, all the requirements of the defendant's engineers and inspectors. There was a definite test appointed for November 15th, when the whole thing worked perfectly satisfactorily and without the slightest hitch about it. No sort or kind of complaint was made, and Mr. Brinsmead took possession subject to certain requirements being made; but instead of giving plaintiffs the chance of making those requirements, defendant wrote that he had got a report, and had determined to reject the lift.

Mr. JELF submitted that on the contract there was no case, but if it were held that there was, he contended it could only go to the counterclaim. The learned counsel proceeded to call

Mr. MORGAN WILLIAMS, said he had been an electrical engineer for 16 years, and was inspector to the Chelsea Vestry. On Dec. 19, 1898, witness inspected and tested the plaintiffs' lift, and he did so again on January 30th and February 21st, 1899. There was a motor on the base of the premises, and buttons and a press-board in the lift to work it and carry it up and down. Speaking as an experienced engineer, he found the lift in an improper condition, and any slight displacement might have upset it. There had been very violent sparking. It was a metallic contact, and insufficient; one ought to have been of carbon instead of metal, and the result was a great deal of sparking and fusion. He did not consider it was a workable machine; it was badly designed and badly made. Witness was proceeding to describe in detail the defects he found, when

His LORDSHIP suggested to parties the advisability of his having the assistance of a scientific assessor.

Counsel on both sides consulted with their clients, and then

Mr. JELF intimated that they felt it would be an enormous advantage to have the assistance of a skilled technical expert, and Prof. Kennedy had been agreed to by both of them.

The further hearing was then adjourned, application to be made within a week for another fixture.

THE ANGLO-AMERICAN TELEGRAPH COMPANY *v.* POWER & DODD.

AT the Court of Admiralty, Dublin, on 15th inst., before Mr. Justice Johnson, this case was heard. The plaintiffs are the owners of trans-Atlantic telegraph cables, and their shore ends land in the island of Valentia, co. Kerry. The defendants, who are fish buyers and exporters, were the owners of a hulk used for the storage of ice during the fishing season outside Cahirciveen. The plaintiffs' case was that towards the end of March, 1899, the defendants, though frequently warned that the ice hulk was insecurely moored, allowed her to drag her anchors, with the result that they fouled one of the plaintiffs' cables, causing serious interruption to business and a cost of repair amounting to £100. The defendants contended that their ice hulk dragged her anchors owing to inevitable accident, there being a furious gale, which caused many wrecks at the time in Valentia Harbour, and, secondly, that the damages claimed were entirely excessive, inasmuch as the electrical staff brought from London had not only repaired the injury caused to the cable by the defendants' anchors, but many other defects, due to other circumstances. It was further argued that the ice hulk was not a ship within the meaning of the Merchant Shipping Acts, and that the Court of Admiralty had, therefore, no jurisdiction in the matter.

Counsel for the plaintiffs—Mr. Sergeant Dodd, Q.C., the Queen's Advocate, and Mr. J. B. Sandford. For the defendants—Messrs. D. B. Sullivan, Q.C., Ignatius O'Brien, Q.C., and A. M. Sullivan (instructed by Mr. D. M. Moriarty, Killarney).

His LORDSHIP held that the hulk owned by the defendants was a ship, that he had, therefore, Admiralty jurisdiction, and he assessed damages at £83.

THE METROPOLITAN ELECTRIC SUPPLY COMPANY'S SUPPLY.

ON Wednesday afternoon a deputation of the residents of Marylebone, who have suffered from the failures of the Metropolitan Electric Supply Company to supply them with current, waited on the President of the Board of Trade, at the Board of Trade offices, Whitehall Gardens, in reference to the matter. Sir Courtenay Boyle was present with Mr. Ritchie.

Dr. FLETCHER LITTLE, in introducing the deputation, said it consisted of customers and users of electricity supplied by the Metropolitan Electric Supply Company, who had suffered, and were suffering from the failure of the company to supply them continuously. For several years past the current had been unequal, and occasionally it had failed altogether. During the past two or three months the failures had been almost daily, and sometimes twice a day. The duration of the failure had frequently extended over several hours. Sometimes the company had given them notice of its intention not to supply during several hours in the afternoon, but in the majority of cases the failure has taken place absolutely without notice. When the failures occurred, other lights had to be hastily obtained, and this was a serious matter, particularly in business establishments. In some establishments it was a matter of considerable danger because improvised lights had to be used in rooms stocked with inflammable material. The light had been turned off during important surgical operations at Middlesex Hospital, and private surgeons and dentists and been very greatly inconvenienced. Another complaint was the attempt to impose higher voltage on the consumer. But while the company was neglecting to supply its customers in Marylebone, at the same time it was asking the Vestry to allow it to take up the streets and lay down mains to carry current through the parish to supply another parish. They had not come before the Board of Trade before they had tried to help themselves, but their complaints had been unavailing. They felt this the more because they had to pay so much for their electricity. At Shoreditch only half the price was charged as in Marylebone, while in other districts of London large rebates were allowed to small consumers. The Vestry had taken a summons out for default, but the magistrate adjourned the summons for three months, and under the circumstances they were advised that it was no good for them to take out a summons. There was no provision giving the company's consumers any compensation for breach of contract to supply electricity. The company, in that respect, appeared not to have the liability of the ordinary trader. They therefore prayed the President of the Board of Trade to introduce, either in a provisional order or Bill, a clause placing the company in the same position as other trading companies, and giving consumers the right to compensation for any breach of contract. If that were done, the consumers would be able to protect themselves.

Dr. FARDON said that the Middlesex Hospital authorities some years ago spent a large sum of money in electrically equipping the hospital, and for some years the supply was satisfactory; but notably in the past 12 months they had been put to very serious inconvenience indeed.

Mr. RITCHIE: Has there been any amelioration of the situation since December 15th.

Dr. FARDON said that on December 20th and 23rd, and on January 4th they had absolute failures—on one occasion for 45 minutes.

Mr. T. W. BAKER, consulting electrical engineer, gave evidence of several failures of supply, one of which occurred as late as the previous day.

Mr. PAXTON, of Great Portland Street, and Mr. JOHN LEWIS, also gave instances of the failure of the company's supply.

The Right Hon. C. T. RITCHIE, in reply, said he thought the complaints had been universally acknowledged, and the names of those who had signed the memorial made it quite apparent that it was a matter of very great importance, and one for which, if it were possible, a remedy should be found. That the complaints had been fully justified there could be no question. The Board of Trade had communicated with the company more than once, and a letter had been received from the company that morning in which they stated that their works had been completed since December 15th, and that there was no reason to apprehend any further failures. From the statements of Dr. Fardon and Mr. Baker, it would appear that that statement was not correct. According to the admission of the company itself, it was greatly lacking in foresight and greatly to blame for not having seen what the development of its supply would be, and for not having provided in proper time for the demand which would be made upon it. The company had undoubtedly incurred very great expense in the erection of their Willesden works, and it said that there would be no further grounds of complaint. It would be his duty to communicate with the company and tell it of the statements that had been made that day. But there had really been no suggestions made as to what the Board of Trade should do, because the company was just as liable to be proceeded against for breach of contract as any other trading company. With regard to the complaints they had made, he was afraid that practically the Board of Trade had no power. The company was liable to penalties for not maintaining a constant supply, and it was open to an aggrieved person to take action. Action, indeed, had been taken, and the summonses would come up again at the Marylebone Police Court, and although, perhaps, it might be very little satisfaction to those who had suffered, should the company be penalised, still it would have the effect of making the company perform its duty. The only real remedy for defaults of that kind was competition, and it was perfectly clear from the Act of Parliament that competition in electric lighting was intended, and competition had been allowed to a very great extent. The Marylebone Vestry applied for a provisional order, and it passed a second reading in the House of Commons, but for reasons which he could not deal with the Committee would not confirm the order. At the present time another company was applying for a competing order within the parish, but the Vestry was opposing the application on the ground of the great interference to the streets which would be involved. Having regard to the complaints which had been made, it was rather formidable for the Vestry to object. Still they would have to consider the objection of the Vestry to the application and deal with it in the way they would consider best for the public interest. With regard to that deputation, he trusted that it would have the effect of causing the company to mend its ways.

Dr. FLETCHER LITTLE said it was the idea of the Vestry to buy out the existing company, and therefore they did not want another company in the parish. There was no Bill before Parliament that year, because the Vestry was an expiring body.

Mr. CHICK said what the Vestry really wanted was power to compete with the company.

Mr. RITCHIE: There are two parties then. I will leave you to fight it out.

can lead them to assume that I advocate the use of "insu-

by the Vestry.

ON THE PROTECTION OF ELECTRIC POWER TRANSMISSIONS FROM LIGHTNING.*

BY J. T. MORRIS.

(*Continued from page 73.*)

6. Arc extinguished by repulsion by electro-magnet.

In 1885 Prof. Elihu Thomson devised a type of lightning arrester, which has been extensively used and with marked success, especially for continuous current circuits.

It is known as the magnetic blow-out arrester. Its action depends on the principle that a movable conductor either in the form of a wire or a heated gas carrying a current tends to move across the lines of force in a magnetic field.

Fig. 16 is taken from a photograph of a pair of these Thomson-Houston arresters connected in series for use in constant current arc-lighting systems of more than 75 lamps.

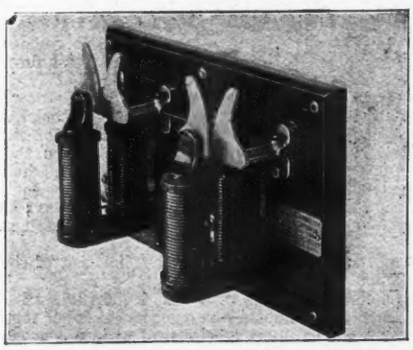


FIG. 16.—THOMSON-HOUSTON MAGNETIC BLOW OUT ARRESTER (CONSTANT CURRENT CIRCUITS).

Between the poles of the electro-magnets, which are always in circuit, are fixed two curved metallic horns; the shortest air gap is at the bottom of the horns, and is in a strong magnetic field. One horn is connected to the line, the other to the earth, or, as in the case of another arrester, placed in series with the first. If a lightning discharge causes an arc to start across the small air gap, the arc is forced upwards in virtue of the mutual action between the current and the magnetic field to a position where it is too long to be maintained.

Arresters such as these are probably more used for protecting overhead series arc circuits than any other type.

For use on constant potential circuits up to 300 volts the form shown in fig. 17 is employed, the principal difference being that the electro-magnet is only excited at the moment an arc starts across the horns, the coils of the magnet being connected in series with

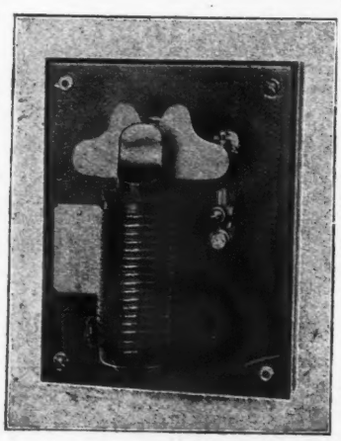
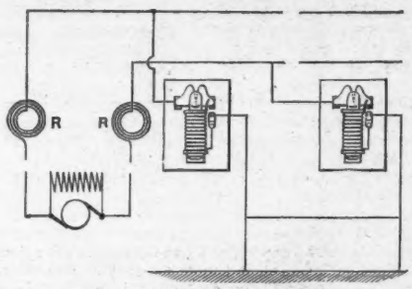


FIG. 17.—THOMSON-HOUSTON MAGNETIC BLOW-OUT ARRESTER (CONSTANT POTENTIAL CIRCUITS.)

the spark gap; these coils are shunted by a short spark gap. Hence the path of the discharge is across the main spark gap between the poles of the magnet, then over the short air gap, and so to earth; while the line current following crosses the main air gap, but being far less sudden it passes round the coils of the electro-magnet and then to earth, thereby producing the magnetic field which blows out the arc. The connections of this arrester are shown in fig. 18 for a two-wire overhead circuit. In some forms for direct current circuits of higher voltage a non-inductive resistance of iron strips is combined in the arrester and connected between it and earth so as to limit the short-circuiting current.



R, R, Reactance coils.

FIG. 18.—CONNECTIONS FOR MAGNETIC BLOW-OUT ARRESTER.

For alternating current circuits the electro-magnets are modified, no iron core being used. Two flat coils (see figs. 19 and 20) are placed one on each side of a set of spark gaps. In the particular example shown there are three gaps connected in series, and the arcs

FIG 19.—ALTERNATE CURRENT MAGNETIC BLOW-OUT ARRESTER.

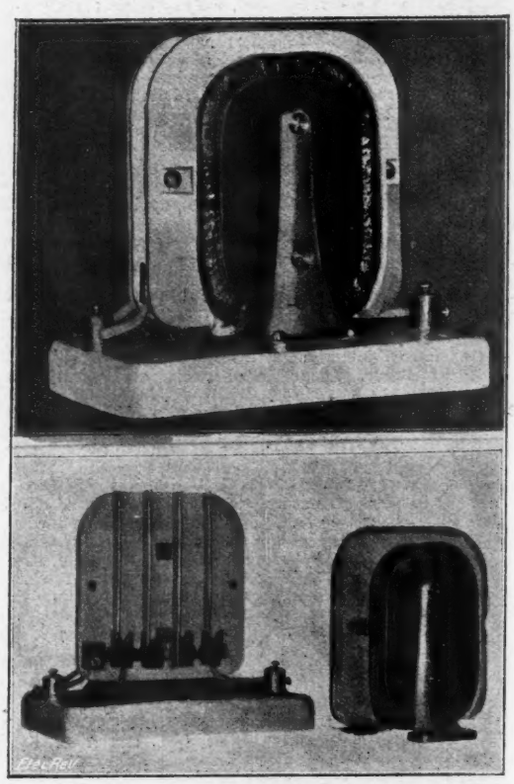


FIG. 20.—VIEW WITH ONE COIL REMOVED.

are driven up the narrow grooves between the flat magnetising coils until they break. Connections are shown in fig. 21. These alternate

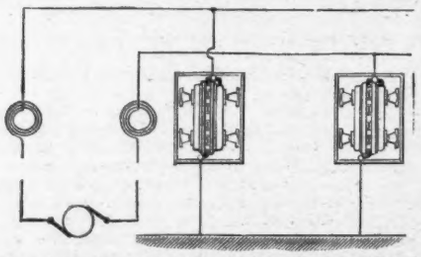


FIG. 21.—CONNECTIONS FOR ALTERNATE CURRENT BLOW-OUT ARRESTER.

current arresters are made for circuits of from 1,000 to over 3,000 volts, and are being used with success in America.*

* Paper read at (a students' meeting of the Institution of Civil Engineers, February, 1898. Awarded a "Miller" prize.

* These arresters have been entirely superseded by the "Short Gap" type above described.—January, 1900.

7. Arc extinguished by use of non-arcing metals.

Wurts' Non-Arcing Metal Lightning Arrester.—The discovery of the non-arcing property of certain metals and alloys is due to Mr. Alexander J. Wurts, of the Westinghouse Electric Company, who early in 1892, after much research, designed and brought into a practical form the non-arcing metal arrester.

Mr. Wurts has contributed very largely, indeed, to our knowledge on the subject of the protection of electric power circuits from lightning.

A few facts relating to this non-arcing property of certain metals will here be of interest.

If three solid cylinders of copper, an inch in diameter, are fixed with their axes parallel to each other, side by side, so that the two air gaps measure about $\frac{1}{32}$ inch, as shown in fig. 22, and a very small piece

Fig. 22.

1,000-volt Short Circuit maintained between Copper Electrodes (Arcing Metal) with Two $\frac{1}{32}$-inch Air-gaps.

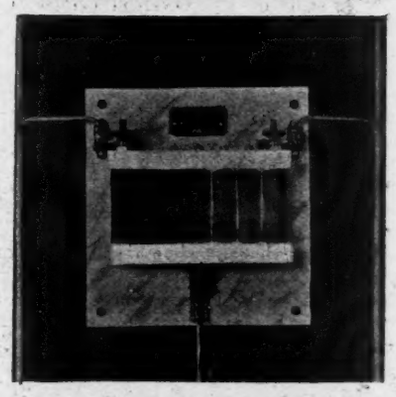


Fig. 23.

Interruption of 1,000-volt Short Circuit between Line and Ground Terminals, on Double-Pole Non-arcing Metal Lightning Arrester $\frac{1}{32}$-inch Air-gaps.

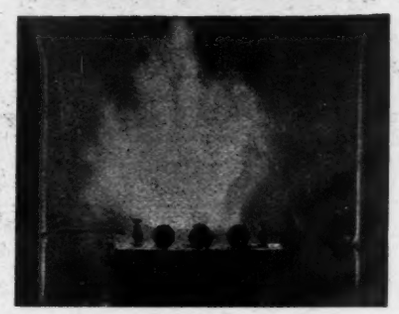


Fig. 24.

1,000-volt Short Circuit maintained between Non-arcing Metal Electrodes with Two $\frac{1}{32}$-inch Air-gaps.

of tinfoil is placed so to bridge each air gap; then, on applying an alternating pressure of 1,000 volts to the outer pair of cylinders by means of a switch, an arc is immediately started, and it will be furiously maintained.

But now, if instead of using copper, which is an arcing metal, a non-arcing metal, such as zinc, were used in the above experiment, then, on closing the switch, the short circuit thus established will be almost instantaneously interrupted (fig. 23); indeed, so rapid is its action, that a 20-ampere fuse connected in circuit will not be melted.

This non-arcing property is confined to a few metals and alloys containing these metals. The most common are zinc and antimony. With these metals, when an alternate current arc is started across a short air gap, about $\frac{1}{32}$ inch, the arc is immediately broken.

It is a remarkable fact that, with long air gaps, they seem to lose completely their non-arcing properties. An example of this is shown in fig. 24, which practically only differs from the previous, in which the arc was immediately extinguished, in the fact that the air gaps are $\frac{8}{32}$th inch instead of $\frac{1}{32}$ inch, showing clearly that with long air gaps an arc of considerable magnitude is easily maintained.

Another point of interest is, that every one of these non-arcing metals fails to interrupt the circuit when a continuous current is used instead of an alternating; though, with 500 volts direct current, the short-circuiting arcs are much smaller and quieter with non-arcing electrodes than with arcing metals.

(To be continued.)

REVIEW.

The Manufacture of Carbons for Electric Lighting and Other Purposes. By Francis Jehl. London: the *Electrician* Printing and Publishing Company.

In the preface of this book the author brings forward several propositions: that for years little has been published concerning the manufacture of carbons; that this is due in great measure to the attitude of secrecy assumed by manufacturers; that any secret there may be lies in the fact that carbons to be good must be well-baked, and, therefore, need a special form of furnace for their production; finally, that there is no reason why the manufacture of high-grade carbons should not be undertaken in every civilised country. The body of the book goes far to establish all these propositions.

In the case of a work of this kind treating of a highly special form of industry it is useful to make the review descriptive as well as critical. We shall, therefore, adopt the author's division of subjects, and treat of them in turn, though not necessarily in the order adopted by him. After a brief description of the chief properties of carbon there is an historical chapter. Carré seems to have been the first, in 1877, to describe a method of manufacturing carbons similar to that now in use. He made a paste of 15 parts of powdered coke, 5 of lampblack, and 7-8 of sugar syrup, and squeezed this by hydraulic pressure through a drawplate so as to yield highly-compressed rods which were baked in retorts at a high temperature. A good account is given of Pritchard's experimental work in 1890, which is chiefly interesting because of his use of graphite as a raw material; graphite is but little used now in spite of its possessing certain obvious advantages.

The materials used for the best-grade carbons are 80 per cent. of lampblack and 20 per cent. of tar; for second and third-rate mixtures a portion of the lampblack is replaced by gas retort carbon or petroleum coke. A "common American mixture, also for battery plates and electrodes," consists of 80 per cent. of gas retort carbon and 20 per cent. of tar. Carbon brushes have a similar composition, but contain 10—15 per cent. of plumbago replacing the coke. The fact that lampblack is the chief constituent of high-grade carbons warrants the description of methods of producing that material, for it is greatly to the interest of the manufacturer of carbons to make lampblack himself rather than to buy it at a price which has to cover another manufacturer's profit, and perhaps a heavy charge for carriage. Lampblack is made by allowing any carbonaceous material which is capable of burning with a smoky flame to burn under such conditions that it produces a maximum quantity of soot. Such carbonaceous materials are, in general, fatty or resinous substances or hydrocarbon oils, and the various devices for burning them are alike in these essentials, viz., that the flame should be kept going vigorously enough to consume or break up all the fuel applied to it, and not merely to distil away unchanged any considerable part of the fuel, as it would tend to do if the fuel were too lavishly supplied; also that the air supply should be sufficient to maintain combustion, but not to complete it. Under these conditions oxidation is selective; of the hydrogen and carbon composing the fuel, the hydrogen suffers oxidation more readily and completely than does the carbon. With a limited supply of oxygen, some carbon, associated, it may be, with a little hydrogen, passes off as soot. The condensation of this soot is effected in long flues and chambers sometimes supplemented by louvres, and cloth or wire screens. The process, even in its most modern form, is somewhat primitive and very wasteful, the yield of lampblack being at most 20—25 per cent. of the weight of fuel consumed. This is not of great moment, for the maker who prepares lampblack for use as a relatively costly pigment, but is important for the maker of carbons, who needs the lampblack simply as a form of carbon free from ash. It may reasonably be asked whether it is not possible to prepare lampblack, perhaps of coarse grain, and therefore not fit for use as a pigment, but free from ash and from volatile impurities, in some more economical way, so as either to use cheaper raw materials, or to obtain a larger yield. Such an improvement is evidently more likely to be effected by a carbon maker having his own lampblack works, than by the maker of lampblack for all

purposes, who is often a manufacturer of printing ink and pigments, and regards the carbon-maker's needs as a secondary matter. Well-made lampblack should be nearly free from oily matter, but if faulty in this respect can be improved by calcining in closed vessels.

That part of the book dealing with the preparation of lampblack is clear and good. A curious error on p. 191 reverses the specific gravities of water and tar by making "the water settle at the bottom;" this does not seem to be a slip, because a precisely similar statement occurs on p. 37. It is true that tar and water are separable by subsidence, but the tar it is that subsides. The remaining raw materials may be dismissed in a few words. Retort coke should be hard and lustrous, and should contain as little ash as possible. Petroleum coke is never free from volatile matter, and must be calcined before use. The tar, as we have said above, should be freed from water. It will be seen that all these raw materials have been chosen because, having regard to their price, they are the best forms of carbon, containing but little hydrogen and nearly free from ash, which are commercially available. It is true that tar consists of hydrogenated bodies, but even in them the percentage of hydrogen is small. All things considered, tar is as good and cheap a binding material as can be obtained, and has displaced the sugary concoctions of earlier days.

The manufacture of carbons from these materials is a very simple matter. In all cases the solids are intimately mixed with the binding agent, so as to form a mass which is plastic at high pressure. This mass is squeezed through a die to form rods, and the rods are heated to so high a temperature out of contact with air that the binding material is carbonised and its volatile products are driven off, leaving a coherent stick of nearly pure carbon. In the case of high-grade carbons no grinding process previous to mixing is necessary. The lampblack is already fine enough, and can be at once mixed with one-fourth its weight of tar in an ordinary kneading machine. The mixture may be heated to decrease the viscosity of the tar and thus make the mass more plastic and kneadable. It is usual to consolidate the mass further by pounding in a sort of stamp-mill and then pressing by hydraulic pressure into cylindrical cakes suitable for the final moulding into rods by means of a second hydraulic press. When inferior grades of carbons are made from retort carbon or petroleum coke, this material must be ground to a fine powder before it can be mixed with tar and moulded. The grinding machinery may consist of stamps followed by edge-runners, and does not differ materially from that used in other industries. It must be remembered, however, that grinding hard carbons between steel surfaces abrades so much metal that the ground material is sensibly contaminated. This is an additional reason for the inferiority of carbons made from retort carbon and petroleum coke instead of lampblack. Cored carbons are made by squirting the plastic mixture through a die having a needle fixed in its centre so that the carbon rod has a small central hole throughout its length, and filling this with lampblack or ground carbon (from broken rods) made into a plastic mass with water-glass. This waterglass must be silicate of potash, not silicate of soda, because the latter gives an objectionable yellow colour to the arc. It is by no means clear why a silicate which leaves a considerable amount of ash should be preferred as an agglutinant, but such is the practice.

When all these operations have been duly performed, the quality of the carbons is still doubtful. As the author says the key to making good carbons lies in the furnace. Formerly carbons were baked in any kind of discontinuous furnace which would bring them to a high temperature. Nowadays, a properly arranged carbon factory has a good Hoffmann furnace, such as is used for burning bricks, pottery, and cement, which is continuous and regenerative. The carbons are filled into fireclay boxes or retorts, and packed into chambers where they are heated by producer gas. The waste products go to warm the carbons in the next chamber to that in which the temperature is at its highest, and air to feed this latter is drawn in through chambers containing carbons that have been already heated and are still very hot. There is no difficulty in attaining a temperature of 1,400—1,500° C., and from the nature of the case the slow heating of the raw carbon is assured. The author deals with this part of his subject in a thorough manner. We do not know that it was necessary for him to describe the ordinary gas producer, but he does, and that clearly enough. It is in his description of the reactions in a producer that he goes astray from insufficient knowledge of chemistry. The furnace itself, in its different forms, is well and clearly described, and the needs of small makers, such as those who manufacture their own electrodes for electro-chemical works, are not forgotten. That carbons must be gradually heated and ultimately baked, and at the highest attainable temperature, is the short and cogent sermon which the author has to preach. Sorting and packing are minor matters adequately spoken of. The use of Seger's cones for estimating furnace temperatures, and the practice of analysis of furnace gases are subjects briefly dealt with; they are not out of place. There is a chapter of estimates of cost of plant and working, which may be useful to the intending manufacturer, who, on the figures given, may expect fat profits.

These are the chief contents of the book. It remains to criticise the work as a whole. Those who look for graces of style will be disappointed. The book is written in bald, clumsy language, ungrammatical and colloquial in places, and giving evidence of its extra-Britannic origin. But for all this, it is plain, straightforward and practical. Its author writes as one having authority, and not as the scribes. He has clearly grasped the fundamental principles of carbon manufacture, and he spares no pains or iteration to make his reader also understand them. Of course there are lacunæ here and there. For instance, one would like to have a comparative table of the chemical composition and physical properties of typical carbons, good, bad, and indifferent; also some indication of the reason of the inferiority of carbons made from retort carbon to those made from lampblack—whether it is due to coarseness of grain, presence of ash, or some different cause. Further, a special section on electrodes would be welcome.

The use of carbon rods for arc lighting is no doubt enormous, but already there is a large demand for electrodes in electric furnaces and in electrolytic processes. At present these products seem to be the Cinderellas of the trade; they have least carbon and most ash. They are usually made from the cheapest class of mixture, and are generally inferior to that original and homely material retort carbon, as has been shown by experiments made by Messrs. Stanger and Blount, and cited by the author. There is certainly no reason why this inferiority should continue, and it will be to the advantage of the carbon maker if he studies the needs of those new industries which are arising and require wares similar to, but not identical with, those needed for lighting. We invite the author's attention to this subject in his second edition. These, however, are small defects, and in no way deter us from commending the book as a useful monograph on a subject hitherto surrounded with much unnecessary mystery.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING JAN. 17TH, 1899		WEEK ENDING JAN. 16TH, 1900.	
Adelaide	Value £44	Alexandria	Value £147
Amsterdam	30	Amsterdam	55
Barcelona	33	Auckland	30
Bombay	510	Barcelona	70
Boulogne	76	Bombay	144
Bremen	50	Buenos Ayres	82
Brisbane	15	Calcutta	3,023
Calcutta	763	„ Teleg. m'f'tures ..	156
Cape Town	563	Cape Town	778
Christiania	360	Christchurch	45
Colombo	27	Christiania. Teleg. wire ..	117
Copenhagen	17	Colombo	523
Delagoa Bay	38	Copenhagen	105
Durban	669	East London	64
East London	337	Flushing	13
Gibraltar	23	Gothenburg	57
Hamburg	110	Hong Kong	31
Helsingfors. Teleg. wires ..	357	Melbourne	202
Hiogo	12	„ Teleg. wire	306
Malta	40	Montreal	88
Rangoon	31	Napier	28
Rio de Janeiro	80	Ostend	38
Santander	11	Port Elizabeth	62
Singapore	907	St. John's (N.F.) E. detonators ..	25
		St. Petersburg. Teleg. mat. ..	1,443
		Shanghai	680
		Singapore	80
		Stockholm	88
		Sydney	127
		Yokohama	269
Total ..	£5,093	Total ..	£8,786

Foreign Goods Transhipped.

Brisbane. Teleg. mat. .. Value £96

Annual Dinner.—The employés of Messrs. Rosling and Appleby, of Bradford, held their eighth annual dinner at the "County Restaurant," on Friday the 12th inst., when about 150 sat down. After dinner, Mr. Appleby presided at the concert, at which an amount was collected for the Mayor's fund in aid of the reservists' wives and families.

Auction Sale.—In our sale advertisements this week particulars are given of an auction sale to be conducted by Messrs. Wood & Newland, of the plant, machinery, stock, &c., of Messrs. Heath, Snoxell & Co., Ltd. (in liquidation), Apollo Iron Works, Birmingham, on February 7th.

Bankruptcy Proceedings.— At Newcastle last week, William Dalzell, electrical engineer, Newcastle, came up for first examination. He stated in answer to Mr. J. G. Gibson, official receiver, that he started business in June, 1897, with £850 capital, which came to him from his father's estate. He began with small jobs at the outset, and his first contract of any size was lighting a church at Heaton, £60. Since then his chief contracts had been with Mr. J. Graham for electrical installations at the Turk's Head Hotel, Newcastle, and the Tynemouth Aquarium; and an installation at Middlesbrough. The amount of the latter was £1,150, but it cost him £1,300. The work he put into the Turk's Head was of the value of £500, and had he been paid the full amount he would have made about £100 profit. As a matter of fact he received only about £100 for the work. He had done £1,450 worth of work for a Mr. Graham, had lighted the Turk's Head and the Aquarium, and had received only £325. That was rather cheap. The net effect of his dealings with Mr. Graham had been to convert him from a capitalist to the moderate extent of £850 (exclusive of the sum of £200 which he borrowed) into a bankrupt with £300 to £400 of liabilities. He had no means or he would have taken action against Mr. Graham.—The examination was adjourned till January 25th.

A receiving order was made on December 29th against W. Dalzell (W. Dalzell & Co.), electrical engineer, Newcastle-on-Tyne.

Notice is given in the *London Gazette* of a first and final dividend of 2s. 6d. in the case of C. H. Kuching, plumber and electrical engineer of Kingston-upon-Hull, payable at the offices of W. R. Locking and Scott, Bowlalley Lane, Hull.

Liquidations, Dissolutions, &c.—Notice of intended dividend in *re* London Provincial Electrical Company, Limited, of 110, Cannon Street, E.C., appears in the *London Gazette*. The liquidator, H de V. Brougham, 33, Carey Street, W.C., will receive proofs until January 22nd.

The New Electricity Supply Syndicate, Limited, is winding up voluntarily. Mr. F. King, 39, Victoria Street, S.W., being liquidator.

On Wednesday Mr. Justice Wright, sitting in the Chancery Division, made an order for the voluntary winding up of the Phæton Electrical Company to be continued under the supervision of the Court.

Books Received.—*A travers l'Electricité*, par Georges Dary, 440 pp., fully illustrated. Librairie Nony et Cie., Boulevard St. Germain, 63, Paris. 10 francs.

"Signalling through Space without Wires," by O. J. Lodge. London: The *Electrician* Printing and Publishing Company, Limited. 5s. net.

"Indicator Diagrams," by W. W. F. Pullen. Manchester: The Scientific Publishing Company. 6s. net.

Catalogues, Calendars, &c.—From the Eastern and Eastern Extension Telegraph Companies we have received a very serviceable pocket memoranda book in which information is given of the rates per word from the United Kingdom to any part of the companies' system. Tables are included showing the difference of telegraphic time between Greenwich meantime and a number of places abroad. A useful map folding into a small compass shows the various cables owned by this and other companies.

From the British Thomson-Houston Company there has come to hand an illustrated pamphlet, No. 49, relating to transformers.

From Messrs. Simon, Berry & Co., manufacturing electrical engineers, we have received a pictorial wall calendar. On the various sheets are interesting photos of the North Staffordshire, York and Ainsty, Potterton Hall, Albrighton, and Wheatlands hounds.

Messrs. Hunt & Mitton, of Birmingham, send us their small sight-feed syphon list, in which prices are found of their centrifugal automatic crank pin oiler, and various other patterns of oil syphons, which are illustrated.

From Messrs. Mather & Platt's London office, 14, Victoria Street, S.W., we have received leaflets relating to their enclosed motors, of which details and prices are given in tabulated form.

Circular No. 1,010 of the British Westinghouse Company's series, deals with their "self-cooling transformers." Illustrations, efficiency curves, and so on, are given therein.

Charge of Stealing Electricity.—The charge of fraudently abstracting electricity by, it was said, diverting the current under circumstances which have been already noted in the ELECTRICAL REVIEW, preferred against Alfred John Harrison by the Vestry of Hammersmith, ended last week at the London County Sessions by the grand jury returning, after careful consideration, "No bill."

County of Durham Electric Supply Scheme.—The Bill which has been deposited for next session to incorporate the County of Durham Electric Power Supply Company, proposes to empower that company to supply "electrical energy in bulk" within "the districts of the Poor Law Unions of Gateshead, South-Shields, Chester-le-Street, Sunderland, Houghton-le-Spring, Darham, Easington and Hartlepool." The capital proposed to be raised by the company is £270,000, divided into 27,000 shares of £10 each, and with the right to borrow on mortgage of their undertaking such sums as they think fit, not exceeding in the whole £90,000. The first directors of the company will be Mr. Emile Garcke, Mr. William Leonard Madgen, Mr. John Smith Raworth, Mr. Robert Percy Sellon "and one other person to be nominated by them." For the purposes of this company it is proposed to erect two generating stations, one at Gateshead on the southern bank of the River Tyne, the other at Harraton, on land lying between the North Biddick Colliery and the River Wear. The Bill empowers the company to enter into any agreements with any lighting authority or other body "entitled to demand a supply of electrical energy" for the supply of "energy in bulk at such price and on such terms and conditions as may be agreed."

Electrical Engineers and the War.—A timely offer has been made by Messrs Julius Sax & Co., Limited, to the Imperial Yeomanry Hospital Corps, and has been accepted. As at present arranged, it is expected that the Hospital Camp will consist of from 50 to 60 tents, each containing 10 beds, all to be intercommunicating with bells and indicators in a special mess tent. Messrs. Sax have agreed to present to the Hospital Corps a complete outfit of pushes, bells and indicators for each tent. For the purpose of portability, they are making a special indicator on an extended backboard, carrying dry cells in a separate water-tight compartment. The indicators consist of the firm's registered electrical replacement movements, and will have an enamelled zinc as well as a glass front, which latter is made to slide in from one side, so as to ensure easy replacement in case of breakage. Instead of the usual brass terminals, the connections will be brought to the top of the board into two pin wall plugs. A water-tight bell will be placed in the top centre of the board. The whole of the woodwork will be of waxed teak, and will be made as near water-tight as possible. The connections between the mess tent and the beds will be water-tight twin flexible cord, all connected ready for use with cocus pear pushes at one end, and two-pin plugs at the other end for insertion into the wall plugs on the indicator board. Spare parts are being sent for replacement in case of emergency. At the request of the Committee, Messrs. Sax are allowing one of their electricians to volunteer to go out with the Yeomanry Corps to superintend the fixing, &c., of the bell system. He will be paid by the Government while out there, and his place will be kept open for him.

The *Essex Herald* says that on Friday night the Chelmsford Electrical Engineers established a successful communication by searchlight between the old Arc Works in Moulsham Street and Mr. Jackson's engineering works on the Baddow Road, a distance of about one mile. On Saturday the apparatus at Mr. Jackson's was moved by traction engine to the top of Danbury Hill, and as soon as darkness came on a detachment under Lieut. Pott had a capital beam working the Morse code in the direction of the old Arc Works—a distance of over five miles. At the works at Chelmsford the operations were under the charge of Sergt. Eatwistle. The bright moon was immediately behind the "drum" which cast the beam at Danbury, and interfered considerably with the working. It is stated that the electrical volunteers at Chelmsford have received large accessions to their strength during the past week, many including several of the Arc Works pupils—joining in the hope of going out to South Africa. Nothing definite is yet known as to who will go with the contingent of electrical engineers—Mr. Crompton, it will be recollected, has offered a company of 50, to be drawn from the companies in and around London—but if those now joining are to go, the Government regulations will have to be altered, since the present regulations says that none but those who have made themselves efficient for 1899 will be accepted.

Falsifying Accounts.—A. W. Longman, charged before Mr. d'Eyncourt at Greenwich with stealing £200, by falsifying the accounts of his employers, Messrs. Elliott Brothers, has been committed for trial at the sessions.

Fire Brigade.—In consequence of the continued extension of their works at Hammersmith, the "Robertson" Lamp Company have found it advisable to institute a trained fire brigade for fire protection purposes in the factory. The company have engaged the services of Ex-Chief-Superintendent Dowell of the Metropolitan Fire Brigade as instructor.

Plant for Sale.—From an advertisement in this issue it will be seen that the Corporation of Carlisle has for disposal a set of electric lighting plant recently used in the public library. It comprises gas engines, dynamos, switchboard, fittings, &c.

Prism Globes.—We understand that the Prism globes and fittings are being installed on the streets of Beckenham for the street lighting by glow lamps.

Society of Model Engineers.—At the meeting of this society, held at the Memorial Hall, Farringdon Street, E.C., on January 9th, the particulars of a competition were announced, in which the society offers gold and silver medals for the best engineering and electrical models made by the members. The next meeting will be held on Wednesday, February 7th, when in addition to the usual show of models, there will be a lecture by Mr. Stanley J. Harding on "High-Tension Electricity," illustrated by numerous experiments.

Turbines at Laxey.—We understand that the turbines installed at Laxey for the electric tramways (to which reference was made last week) were supplied by Mr. Frederick Nell, they being of the well-known "Victor" type. Mr. Nell planned and carried out the entire installation, which is stated to be giving complete satisfaction.

1899.—Messrs. Browett, Lindley & Co., (1899) Limited, of Patricroft, whose capital was largely increased last year by a public flotation of the business which was previously a "Private Limited," report an extreme pressure of work throughout the whole of the past year and a great increase in the size of the engines generally demanded. They start the year 1900 with a value of orders largely in excess of anything hitherto experienced, and which would have been quite beyond their capacity to execute had it not been for the very large extension of their works which is now nearing completion. As an indication of the extent of these additions, the new erecting shop is 370 feet long, about 50 feet span, and has a height under the 25-ton electrical travelling crane of 28 feet 6 inches. A large quantity of heavy machine tools, many of them ordered from America on account of the impossibility of obtaining reasonable delivery from home firms, are now due for early delivery, and some have already been received and installed. Among the plants they delivered during last year, we may mention the following:—Three engines of 500 H.P. each for electric lighting and traction for the Corporation of Ashton-under-Lyne, four engines of 500 H.P. each for electric traction for the Norwich Corporation, two engines of 200 I.H.P., and also two large condensing plants for electric traction for the Coventry Corporation, one 200-H.P. engine for electric lighting at Prescot, Lancashire, one 500-H.P. for the Altrincham Electric Supply Station. In addition to the above a large number of ship-lighting plants have been supplied and many installations for power transmission in iron works, collieries, cotton mills, &c., so that the works have been more than fully occupied during the whole year. The great extension to their works mentioned above was not made a moment too soon on account of the great number of large engines which have been ordered since, including eight 1,500-H.P. engines for the Salford Corporation, one 15,000-H.P. for the Liverpool Overhead Electric Railway, one 600-H.P. for the War Office (Woolwich Arsenal), one 300-KW. set for the extension of the Wallasey electric light station, one engine of 100 H.P. for the electric lighting of Colwyn Bay, one engine of 150 H.P. for the Middlesbrough Corporation electric light station, two 200-KW. sets for the British Electric Traction Company, in conjunction with Messrs. Bruce Peebles & Co., for Maybank station, one 500-H.P. plant for Messrs. Sir W. G. Armstrong, Whitworth & Co., Limited, Manchester (who already have three other similar plants at work), and a large number of sets ranging from 500 to 300 KW. for private customers. Despite their heavy order sheet the firm inform us that as all their standard sizes of engines from 50 to 400 H.P. are now regularly built for stock in anticipation of orders, they are able to give very favourable dates of delivery for these engines, and they find that this has been of the greatest assistance in enabling them to secure many orders which they must otherwise have lost.

Messrs. Geipel & Lange report that their business during the past year has steadily increased in all branches. The sales of Geipel steam traps have been nearly double that of any previous year, they have been fitted on the new royal yacht, and on a large number of H.M. war vessels, while orders have been received from most of the foreign Admiralties. About 70 of these traps will be used for draining the steam pipes at the forthcoming exhibition in Paris. The new bayonet lampholder introduced by this firm is meeting with approval, more especially for 200-volt work. The company has installed a large and increasing number of alternating current motors and generators, all on the Brown-Boveri system. Among a number of country house lighting schemes with which they have been connected, oil engines have been used in two cases, viz, in that of Sir Thomas Richardson, M.P., and in that of Mr. Arthur Gladstone. A Waverley turbine is being used for lighting a house for Captain Sergison, of the Scots Guards.

Trade Announcements.—The Shillingford Works Company, Limited, announce that in consequence of the increasing demand for the special goods manufactured by them, and the inaptness of their works for further expansion, they have made arrangements to amalgamate their business with that of the Trusty Engine Works, Limited, at Cheltenham, whose extensive premises afford adequate accommodation for the Shillingford Company's present machinery, in addition to the extra plant that will be put down to undertake the enhanced output required. The name and address of the combined firms will be the Shillingford Engineering Company, Limited, Trusty Engine Works, Cheltenham. The present directors of the Shillingford Company will take seats on the board of the new company, and Mr. W. T. Goold will be retained as managing director, conjointly with Mr. A. G. Halsted, who is at present occupying a similar position with the Trusty Engine Works, Limited. All assets and liabilities will be taken over by the new company. The manufacture of "Trusty" gas, oil, and steam engines, and other engineering specialities, will be continued as heretofore.

Messrs. Rouch, Lambert & Penny, who have for many years been in the employ of King, Mendham & Co., of Bristol, have acquired premises at 6, St. Stephen's Street, for the purpose of carrying on business as electrical engineers, contractors, and manufacturers. They have secured, amongst other contracts, that of lighting the Turkish Baths and Hydro, Bristol, some 200 lights.

Mr. Edward Lomer, of 12, St. Mary Axe, E.C., has been appointed agent in this country of the Accumulator Works (Accumulatoren Fabrik A. G.) of Berlin and Hagen (Westphalia) for the sale of their stationary and portable accumulators and accessories.

The Private Wire and Telephone Installation Company, who have been established nearly six years at 110, Cannon Street, E.C., have, owing to the growth of their business, found it necessary to remove to larger and more convenient premises at 5, Palmer Street, Westminster, S.W.

Mr. E. R. Dolby has taken Mr. Percy M. Williamson into partnership as from January 1st, 1900. The style of the firm will be Dolby & Williamson, and they will act solely as consulting engineers, with the same address as before, 8, Princes Street, Westminster.

ELECTRIC LIGHTING NOTES.

Bangor.—The Council has resolved to borrow £15,900 at 3 per cent. interest for electric light purposes, to be repayable £2,000 in 20 years, and £13,900 in 25 years. Difficulty has, of course, been experienced in getting money at a cheap rate, but a satisfactory arrangement has been made with the Public Works Loan Commissioners.

Barnsley.—At Tuesday's Council meeting Mr. Brady said the committee hoped to give an intermittent supply of electricity in a week or ten days. They intended to give a free supply to those ready to receive it, in order to see that things were in working order.

Barry.—The Urban District Council has decided to oppose the South Wales Electric Power Distribution Bill, and the Cardiff Corporation Bill in the next session of Parliament.

Bass Rock Lighthouse.—The Northern Lighthouse Commissioners have decided to place an electric arc light on the Bass Rock in the Forth.

Basingstoke.—The Town Council has decided to apply to the Board of Trade for a provisional order to supply electricity for all purposes in the borough.

Battersea.—The Electric Lighting Committee have received several inquiries relating to the electric lighting of premises, and at their request Prof. Kennedy has prepared a series of regulations which have just been approved by the Vestry. The rules are preceded by a general statement, which mentions that continuous current will be supplied at 230 volts:—

The full pressure of 460 volts across the outer conductors will only be supplied (on the three-wire system) to consumers of light at the discretion of the electrical engineer, or for the purpose of driving motors having an output of 4 H.P. or more. All wiring work upon consumers' premises must be carried out in accordance with the rules issued by the fire insurance company under which the premises are insured, and the rules and regulations issued from time to time by the Vestry. Any special cases not provided for in these rules should be carried out in accordance with the standard rules recommended by the Institution of Electrical Engineers. The Vestry in all cases lay the surface mains between their own mains and the consumers' premises; will bring the service mains into or upon the consumers' premises at the nearest convenient point to their service boxes, and will fix the ends of their mains into a fuse box. This fuse box will be supplied and fixed by the Vestry. The consumers' mains must be brought out as far as the fuse box and the ends left ready for sweating in, which will be done by the Vestry. The Vestry, on receiving proper notice in writing addressed to the electrical engineer, will point out the position which their main fuse box will occupy. The Vestry will supply, fix, and keep in repair, a suitable meter on the consumers' premises on the house side of the main fuse, and for this meter a rent will be charged half-yearly at rates yet to be fixed. At least 10 days before the supply of current is required in any premises, the consumer, or his contractor acting for him, must fill in and send to the electrical engineer's office the form prepared for that purpose, copies of which can be obtained on application to the engineer. This form states the number of lamps or other apparatus for which current is required, and the supply of current will be given on the understanding that the maximum current applied for is not exceeded. In the event of any alterations being made to the wiring or of additional lamps or other apparatus being added, at least four days' notice in writing must be given to the electrical engineer, and all such new work must be tested by the Vestry when finished prior to the current being turned on to the new or altered circuits. In the event of neglect of this rule, the engineer is at liberty to cut off the whole of the installation until the tests have been made. The consumers are specially cautioned against increasing the number of candle-power of their lamps without competent advice, as by so doing they may cause their wires to be dangerously overloaded. The inspector or other authorised officer of the Vestry is to have free access at any reasonable times to ascertain the quantity of electricity supplied and to examine the meter and main fuse. The official Board of Trade regulations provide that if the Vestry are reasonably satisfied, after making all proper examination by testing or otherwise, that a leakage exists upon the premises of a consumer of such extent as to be a source of danger, then and in such case any officer, duly authorised by the Vestry, may, for the purpose of discovering whether the leakage exists upon the consumer's premises, by notice require the consumer to permit him to inspect and test the wires and fittings belonging to the consumer. If, on such testing, the officer discovers a leakage from the consumer's wires exceeding $\frac{1}{1000}$th part of the maximum supply current to the premises, or if the consumer does not give all due facilities for inspection and testing, the Vestry shall forthwith discontinue the supply of energy to the premises in question, giving immediate notice of the discontinuance to the consumer, and shall not recommence the supply until they are reasonably satisfied that the leakage has been removed. The Vestry issue rules and regulations for the guidance and assistance of consumers and those engaged in installation work. It must, however, be distinctly understood that the Vestry have no responsibility whatever for the work done by contractors on consumers' premises, and are in no way responsible for any loss or damage which may be occasioned by fire or by any accident arising from the state of the wires or fittings in the interior of buildings. The passing of an installation by the Vestry's inspector simply means that it complies with the rules laid down as to insulation tests. The Vestry take no responsibility whatever in respect of testing a consumer's installation on his own behalf.

Birmingham.—There was a partial failure of the electric light in the city on the night of 8th inst., public buildings and other premises being suddenly plunged into darkness. The cause is stated in a local paper to be the fusing of one of the street cables.

Chorley.—Messrs. Lacey, Clirehugh & Sillar have received instructions from the Council to prepare the necessary plans and estimates for the purpose of applying to the Local Government Board for borrowing powers for £22,000 for electric lighting purposes.

Cologne.—It is said that a Cologne company (Helios) is about to erect a large generating station in the province of Posen for distributing power for electric lighting and agricultural and dairy purposes over a wide area. The estimated cost is put at £260,000.

Crediton.—Messrs. Taylor & Field, electrical engineers, of London, recently wrote to the District Council with reference to lighting the town by electricity. The opinion was generally expressed that no such step should be taken at present.

Dartmouth.—The Corporation has referred the electric lighting question to a committee, which has been empowered to call in an expert.

Douglas.—Something like a deadlock has been reached on the question of purchasing a site for the electricity works. The subject was referred back to the Committee by the Town Council a fortnight ago for reconsideration, and they have now adhered to their former motion, and recommended that the site on the South Quay is most suitable, and should be acquired. A long debate ensued, and in the end the motion that the site be purchased was lost by 12 votes to 10.

Dublin.—The promoters of the County and City of Dublin Electric Lighting Company's Bill have approached the Kilmainham Urban District Council with a view to obtaining its support. The company, which is to have a capital of £500,000, undertakes to supply electricity for lighting at 3½d. per unit, and for power at 2d. per unit.

Dunblane.—The Emergency Road Committee will deal with a notice of application for a provisional order for power to supply electric current to Dunblane and Bridge of Allan by the Urban Electric Supply Company, Limited.

Eastbourne.—The Corporation having received the approval of the Local Government Board to their acquirement of the electric light works and to the borrowing of the purchase money, &c., the undertaking was formally transferred by the company to the municipal authority on Monday last week. A cheque for £88,135 (to include £6,000 on account of capital expenditure made by the company for the Corporation) was paid to Mr. Langham, as representing the company. Mr. Brydges now takes the responsible post of electrician, otherwise there will be no immediate alteration in the staff, and affairs at the works will be carried on as usual.

Glasgow.—A partial interruption of the supply to the centre of the city occurred on the 15th inst, due to the blowing of two fuses in street boxes. Fortunately, there is a double supply to this region, so that only half the lighting was cut off. The supply was completely restored in a couple of hours.

Gravesend.—The Town Council will not entertain the request of Messrs. Crompton & Co. for an extension of 12 months' time under the electric lighting agreement, but will proceed to carry out the order on their own account after the 12th prox.

Guildford.—The Guildford Electricity Supply Company was summoned last week for causing a nuisance to exist by sending forth black smoke from the works' chimney. For the company it was stated that the difficulty in securing Welsh coal had hampered it considerably in this respect. The bench "quite recognised that there had been great difficulty in getting coal, but, at the same time, felt they must make an order for the abatement of the nuisance and the prohibition of its recurrence."

Hackney.—At the last Vestry meeting the Finance Committee reported that they had been in communication with the London County Council on the subject of loans for works of electric lighting in the parish, and they proposed, with the concurrence of the Vestry, to take up a loan of £30,000, being the second instalment of the amount sanctioned by the Vestry, and repayable, according to the condition of the Council, within 42 years. The Committee also reported that they had placed upon deposit at the London, City and Midland Bank, Limited, a sum of £47,000, to be withdrawn as and when required, for the purposes of the electric lighting works, and they proposed to similarly deal with all sums raised by way of loans which might not immediately be required. The course proposed by the Committee was agreed to by the Vestry.

Hamilton.—At a meeting of the Town Council last week a recommendation by the Gas Committee to enter into negotiations with the promoters of the proposed electric tramway company for motive power for electric lighting purposes, was unanimously adopted. It was stated that an installation for a town of the size of Hamilton would cost between £12,000 and £15,000.

Hornsey.—Unless the North Metropolitan Electric Power Supply Company agrees to leave out the Hornsey parish in its application for a provisional order, the District Council will oppose it.

Huddersfield.—The electricity supply returns for the past year submitted to the Electricity Committee at the last meeting by Mr. A. B. Mountain, the electrical engineer:—Consumers, January, 1900, 1,082; 1899, 806; increase, 276 = 34·24 per cent. Lamps connected, January, 1900, 70,178; 1899, 54,154; increase, 16,024 = 29·58 per cent. Units metered during 1899, 1,024,593; 1898, 640,714; increase, 383,879, or 59·91 per cent. The maximum load in 1898 was 770 units, and in 1899 1,012 units; increase = 242, or 31·42 per cent.

Islington.—The refusal of the London County Council to sanction loans unless details of the expenditure are furnished to the Council has brought about a serious dispute between the Vestry's Finance Committee and the Electric Lighting Committee. It appears that in 1898 the Vestry decided as a standing resolution that in future no contracts should be entered into for works to be paid for out of loans until the consent of the sanctioning authority had been obtained. A few months previously an expenditure of £72,000 for extension of the electric lighting system was sanctioned on the same condition, and in June last a further outlay of £4,000 for condensing plant was similarly approved by the Vestry. In a report on the subject, which will be considered at to-day's meeting, the Finance Committee inform the Vestry—

> That in direct contravention of the standing order and resolutions referred to—the consent of the sanctioning authority not having yet been obtained—a considerable portion of the plant proposed to be provided under the above authorisations has actually been obtained or is now on order, that liabilities have in consequence been incurred and that a tender has also been accepted for the supply of the condensing plant. The Committee state that they have no desire to hamper the action of the Electric Lighting Committee, being fully aware of the difficulties attendant upon the carrying on of the electric lighting undertaking without a working capital, but the fact must not be overlooked that the standing orders of the Vestry above-mentioned were conceived with the express object of preventing irregularities of the kind now in question. The Committee submit that without some such safeguards it is impossible to prevent the financial arrangements of the Vestry from falling into confusion. They, therefore, recommend the Vestry to emphasise the principle which it has already laid down, that in every case where capital expenditure is involved such expenditure should follow and not precede the sanction of the loan, and that it be an instruction to the Electric Lighting Committee that no contract be entered into or liability incurred on capital account until it has received a report from the Finance Committee to the effect that the Vestry's standing orders have been complied with.

Italy.—A central electric lighting station has just been completed and put in operation in the town of Alessandria. The plant has been supplied by Messrs. Siemens & Halske.

Leeds.—The Lighting Committee on Tuesday had under consideration the question of letting a contract to a certain firm for the construction of transformer chambers in connection with the electric lighting of the city, objection having been taken by some councillors to the acceptance of the tender of the firm on the ground that certain workmen in their employ were not being paid the standard rate of wages. The answer to this plea was that the men were not builders' labourers at all, but navvies engaged in excavating work, and that, therefore, the clause did not apply. The committee decided to write to the firm expressing the opinion that if the labourers were engaged in conjunction with the bricklayers or builders, and working precisely the same hours, they were entitled to be considered builders' or bricklayers' labourers, and consequently ought to be in receipt of the wages recognised in the trade.

London.—The City of London Electric Lighting Company proposes to apply to Parliament for an Act to enable it to purchase additional premises on Bankside; the St. Saviour's Board of Works has decided to oppose the Bill, as the company has not built dwellings to house the people displaced by it some years ago.

Malton.—A special meeting of the Malton Urban Council was held on Saturday last to consider the application of the Northern Counties' Electricity Supply Association for a provisional order of the Board of Trade enabling them to supply electricity in the district. The Council decided to ask the Board of Trade to schedule the whole of the present lighting area except Greengate.

Middleton.—The Corporation has now issued advertisements inviting tenders for the building of their electricity works, in accordance with plans and specifications prepared by Messrs. Lacey, Clirehugh & Co.

Newcastle.—The Bill to confer further powers upon the Newcastle-upon-Tyne Electric Supply Company, Limited, has been duly deposited for introduction into Parliament. The company seek power to acquire three acres of land on which to erect new generating stations, in order "to meet the growing demand for electricity within their area." The land proposed to be taken comprises together over 34 acres, and is situated in the parishes of Wallsend and Walker. Power is also sought by the company to supply "energy in bulk" to the Walker and Wallsend Union Gas Company, the Walker Urban District Council, "or any other local authority, company, or person authorised by Parliament" to supply electricity. Provision is also made to enable the company to enter into agreement with the Walker Urban District Council for the acquisition by the company of the undertaking, powers, and privileges of the District Council conferred upon them by the Walker Electric Lighting Order of 1899. The Bill also extends the company's area of supply to Long Benton.

Northallerton.—At an extraordinary general meeting of the members of the Northallerton Electric Light and Power Company on 16th inst., it was unanimously decided that as the company had gained the public lighting, and the present power of the two engines was used up by the demands, the capital of the company (£2,000) be increased by £8,000 in £1 shares. It was stated that the further demands for the light required extra plant.

Rowley Regis.—The District Council has appointed a committee to consider the question of adopting electric lighting in the district.

Newport (Mon.).—At last week's Council meeting a heated discussion took place over the settlement of the action brought by Mr. S. Taylor, baker, of Llanarth Street, against the Corporation to recover damages in respect of the vibration of his premises, which are near the electric light station, and an injunction. The Corporation had at a meeting in committee resolved to give the legal sub-committee full powers of settlement, and Mr. G. H. Llewellyn now reported that the committee had resolved to purchase the premises outright from Mr. Taylor at £4,500, and pay him £150 towards his costs. Mr. Wilkinson characterised the matter as a great mistake and muddle, not only on the part of the engineers and the committee, but also the Corporation, as they had in a former payment of compensation to Messrs. Phillips & Sons, and now again to Mr. Taylor, paid over £6,000 for vibration. Mr. Little said there had been a great muddle and blunder on the part of the former chairman of the Electricity Committee, as he (Alderman Moses) could have settled this matter with Mr. Taylor for £600 a little while ago and would not do it. With what has been properly termed the "unseemly wrangle" which followed we have nothing to do, but after the heat-wave had passed away Mr. Hornby explained that the settlement was an economical one, as Mr. Taylor would be certain of judgment for some amount in the High Court, the Corporation would have to pay the costs on both sides, and Mr. Taylor or the next occupier would bring fresh actions as long as the vibration continued, and obtain an injunction. The motion to approve the settlement was agreed to. An advance in salary to Mr. Ellis, the office manager of the electricity department, from £150 a year to £200 a year was agreed to.

Redditch.—On the reading of the Lighting Committee's report at last week's Council meeting, it was stated that there had recently been many failures of the electric light. On Friday night the light in the public lamps failed almost entirely. In one street, a member said, there had been no light for a fortnight, and practically the town has been in darkness so far as the public lamps were concerned since Friday. It was explained that the last failure was due to something having gone wrong with the two principal engines. The engineers were making an exhaustive inspection of the engines. The clerk reported that the electrical engineer had made further suggestions, which, if acted upon, would raise the amount required to be raised on the new loan from £7,000 to £8,000, making £21,000. It was decided to apply to the Local Government Board for sanction to borrow £8,000.

Redruth.—Mr. F. G. Gripper, of Edmundson's Electric Corporation, Limited, recently wrote to the District Council as to the position of the application to the Board of Trade for electric light powers, and enclosing draft of the proposed provisional order. The draft stated that the applicants were the Urban Electric Supply Company, Limited, being the same company as that now applying for powers to lay down the Redruth—Camborne electric trams. The Highways Committee will consider the order and report.

Ruislip.—The Parish Council is asking the District Council to oppose the provisional order being applied for by the Uxbridge Company, because it includes the parish of Ruislip.

St. Annes.—The Board of Trade has given its formal consent to the system of supply to be adopted. Tenders have been invited for mains, arc lamps, and incandescent street lamps.

St. Pancras.—We are informed that consumers on part of the area of supply of the St. Pancras Vestry were inconvenienced by a failure of the light for two hours on the 4th inst. It seems that the partial failure arose through the shunt circuit of the new large dynamo being interrupted, causing a reversal of the polarity of the machine, and was not discovered until the dynamo was again put on the supply circuit. In 1898 the Vestry decided to utilise the existing lamp columns for the arc lighting of the Highgate district, but as it has not been found possible to obtain a small arc lamp that will work satisfactorily in series on the circuits, the Vestry have decided to obtain the larger type arc lamps, and to incur an additional expenditure for the purpose, which together with £1,630, the amount of the first estimate, will involve a total expenditure of £2,470.

Sevenoaks.—The Council have resolved to adopt the recommendations of Mr. W. C. C. Hawtayne to acquire a provisional order, and to take the necessary steps to oppose the application for a provisional order by the Electrical Power Distribution Company.

Sheffield.—The City Council has received a letter from the Local Government Board sanctioning the borrowing of £71,120 for the purposes of capital expenditure on the electric lighting undertaking. The original application was for a loan of £100,000.

Shoreditch.—The Finance Committee, at a meeting of the Vestry on Tuesday, reported having considered "the urgent necessity" of providing the initial capital in connection with the central station to be erected at Haggerston. It was therefore recommended that the sanction of the London County Council should be sought to a loan for the total estimated cost upon estimates to be submitted by the consulting engineers. On behalf of the Lighting Committee, Mr. N. Moss explained that the expenditure on the new station would probably amount to £100,000. Mr. J. Cox, chairman of the Vestry, ruled that in the absence of estimates the recommendation must of necessity go back to the Finance Committee. The Lighting Committee reported that they had received a deputation from Messrs. C. and R. Lights, Limited, who had requested to be allowed to declare their consumption of electricity for motive power purposes for the year ended June 24th, 1899, at 100,000 units, so as to entitle them being charged on the lower rate of 1½d. per unit, as per the Vestry's list of charges, although their actual consumption for the year was only 93,385 units. The account against these consumers for the year was 93,385 units at 1¾d., or £680 18s. 8d; at the consumption they wished to declare the account would be 100,000 units at 1½d., or £625. Therefore, should Messrs. Light's request be granted, an allowance would be due to them of £55 18s. 8d. Upon fully considering the matter, together with the correspondence which had passed, and in view of the fact that the extra units might have been run to waste, involving a further loss to the Vestry, the committee recommended that the firm should be permitted to declare their consumption at the 100,000 units, and that the difference of £55 18s. 8d. in the year's account should be allowed them. After some discussion the recommendation was adopted by a large majority. It was decided to oppose the County of London and Brush Provincial Electric Lighting Company's Bill to lay mains through Shoreditch, and to appoint Mr. J. Rider Hunt to prepare the quantities for the new station at Haggerston.

Stockport.—Yesterday (Thursday) afternoon the formal opening of the Corporation electricity works took place. The Mayor (Councillor Thomas Webb) started one of the engines at the station at Millgate, and later the party adjourned to the Police Parade Room for luncheon. The works really commenced supply in December, 1898, and such supply has continued uninterrupted until now. There are now 120 consumers, with 7,700 8-C.P. lamps. The system was carried out under the advice of Mr. J. N. Shoolbred, and is a three-wire continuous, 460 volts across the outers, consumers being supplied at 230 volts. There are two Lancashire boilers, 8 feet 3 inches by 28 feet long, by Messrs. Tetlow Brothers, three 55-KW. dynamos, driven by 90 H.P. engines, and two 140-KW. dynamos, driven by 240-H.P. engines. The dynamos were made by Messrs. McClure & Whitfield, of Stockport, and the engines by Messrs. Willans & Robinson. There are two sets of chloride cells of 750 ampere-hours capacity. Messrs. Crompton & Co. supplied the two battery and one main switchboards. A 6-ton crane (33 feet span) was furnished by Messrs. Higginbottom & Mannock, of Manchester. The first section of the distributing and feeder cables was supplied by Messrs. W. T. Glover & Co. An additional feeder is now ordered from the Messrs. W. T. Henley's Telegraph Works. The plant capacity is equal to 13,000 8-C.P. lamps, not including the accumulators or spare. Public lighting is done by 36 arcs.

Tonbridge.—Tonbridge Council Chamber was the week before last the scene of a *melée*, in which two well-known consulting electrical engineers played leading parts. Three years ago a report *re* electric lighting was submitted to the Urban District Council by Mr. F. Hastings Medhurst, but like so many other small local authorities the Council for the time being allowed the report to lie on the table, and took no steps to proceed with an installation. Tonbridge Councillors, along with many others of their kind from various parts of the country, joined the jovial party which attended the inauguration of the Canterbury electricity works, and as the chairman of the Council puts it, "They all formed an opinion that the work was admirably carried out." Mr. Robert Hammond, it will be remembered, was the consulting expert for the Canterbury undertaking, and by invitation he subsequently journeyed to Tonbridge and lectured in his inimitable and popular manner on electricity. The next development was a request from the Council to Mr. Robert Hammond that he should state his terms as consulting engineer. Mr. Hammond replied by letter agreeing to furnish a preliminary report for 50 guineas, this fee, as usual, to merge into the usual engineering charge if the Council allowed him to carry out the scheme. This communication it was that came before the Council and led to a measure of commercial strife, which does not bring credit to the electrical profession as a whole or to the gentlemen affected in particular. It is not the first occasion, we are reminded, upon which two consultants have entered into combat upon very similar grounds for municipal percentage jobs. We may be allowed to use this undignified phraseology because it is so thoroughly in keeping with the entire incident, so far as we understand it, at Tonbridge.

At the Council meeting Mr. Jones inquired if the Council had not already a report upon the subject which they had paid for.

The Chairman replied that they had a report from Mr. Hastings Medhurst about three years ago.

Mr. East said he should like to know why they were negotiating for a fresh scheme when the first one had never been brought before the Council, and why that one had been actually thrown over. He had no recollection of Mr. Medhurst's scheme having ever been brought before the Council, and, at any rate, he thought they should be off with the old love before they were on with the new.

Mr. Broom agreed.

The Clerk read a letter from Mr. Medhurst, to the effect that he noticed the Council had approached Mr. Hammond in regard to the appointment of consulting engineer, and asking that some correspondence which had ensued on the matter between himself and Mr. Hammond might be placed before the Council.

Various letters written by the two gentlemen to each other were then read.

We do not here propose to enter further into the details of this professional squabble. We have related the bare facts, and we prefer to leave them, though it is just possible that Mr. Hammond may have something to say in regard to the matter. We have only to add that when the correspondence was discussed by the Council, it was resolved to engage Mr. Medhurst to act as consulting engineer for electric lighting purposes.

Tiverton.—The Lighting Committee has considered the best means of carrying out the electric lighting order, and as a preliminary step, they recommended the appointment of an electrical engineer to act as consulting engineer, and that he be instructed to prepare and submit a report on the subject as soon as possible.

(*Continued on page* 105.)

BOLTON CORPORATION ELECTRICITY WORKS.

Last week, by the kind permission of Mr. Arthur Ellis, electrical engineer to the Borough of Bolton, we were enabled to inspect the new generating plant which has been put down for the double purpose of supplying power to the tramways and to the direct current lighting mains. We have at different times referred to the old lighting station, of which the plant under consideration forms an extension, more than trebling the original capacity of the works; and in our issue of February 24th last year we gave illustrations of the Mordey and Ferranti alternators, and a brief description of the plant then existing and in course of erection.

Looking Along the Gangway.

The old boiler plant consists of six Lancashire boilers, 7 feet 6 inches × 30 feet, fitted with Meldrum furnaces; for the new plant there are three boilers of similar type, 8 feet × 30 feet, made by Messrs. Hick, Hargreaves & Co., and fitted with Bennis mechanical stokers. These boilers were constructed for a pressure of 160 lbs. per square inch, in order to ensure a long working life, although they are run at 120 lbs., on account of the fact that the original boilers were built for that pressure.

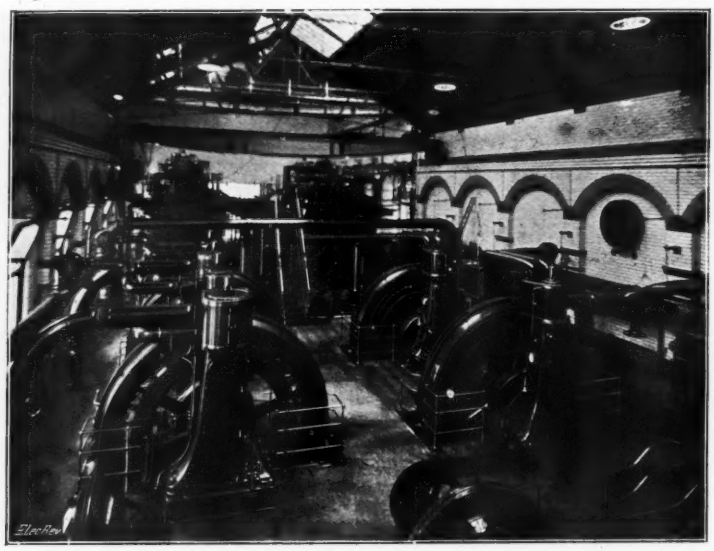
A coal conveyor has been provided, so arranged that the outgoing part of the conveyor chain feeds coal to the hoppers, while the lower or return part removes the ashes; an elevator raises the coal to the conveyor from the bunkers, which are below the outside ground level, and an ash elevator is being fitted up. These appliances, as well as the scrapers of the economiser, are driven by a four-pole Mather & Platt motor, giving 12 B.H.P. when supplied with 21 amperes at 460 volts. There are also two feed pumps, each able to deliver 6,000 gallons of water per

General View from Main Entrance.

hour, driven by Mather & Platt motors. The speed of these is regulated over a very wide range by means of a resistance in the shunt circuit.

At the back of each boiler, in the downtake, a Musgrave superheater is fixed. This is of the same type as those installed at St. Helens, and can be lifted out *en bloc* without any difficulty. A ring main of 18 inches diameter steel pipes runs round both old and new boiler houses; one leg is connected to the boilers direct, the other through the superheaters, and stop valves are fixed at suitable points, so as to isolate any part of the ring.

The economiser is of the "Green" type, and consists of 288 tubes; these are in the circuit of the flue gases from the new boilers only. The exhaust steam from the A. C. lighting plant is led either into the chimney stack, or to one or other of two feed-water heaters situated in the boiler house.



General View from Switchboard.

In the engine room the steam piping is divided into two ring mains, one for the old and one for the new plant; the latter consists of steel pipes 15 inches diameter, and is doubled down the centre of the engine room. The exhaust pipes are 24 inches diameter, and are led along each side of the engine room to discharge into the atmosphere, but each engine is provided with a branch for condensing purposes. The whole of the piping, boiler fittings and valves were made and erected by Messrs. Musgrave and Sons, of Bolton.

The engines are of the vertical cross compound condensing type, with Corliss valve gear, and run at a speed of 100 revolutions per minute.

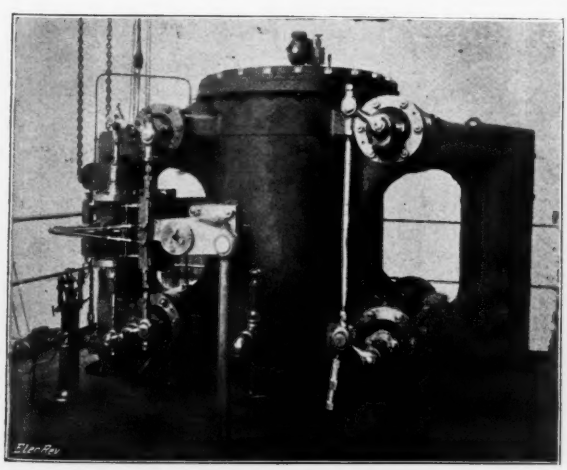
There are two of 1,000 H.P. each, capable of working up to 1,350 H.P., and two of 500 H.P., working up to 650 H.P.; in each case the generator and fly-wheel are placed between the high and low pressure engines, as will be seen in the adjoining view of a 1,000-H.P. set. The cylinders of the larger engines are 24 and 45 inches diameter, with 42-inch stroke;

1,000-I.H.P. Generating Set.

the piston rods are 5 and 5¼ inches diameter in the high and low pressure cylinders respectively; the connecting rods of iron, 8 feet 9 inches long, and tapering from 5¼ inches diameter at the crosshead end to 7½ inches at the crank end; the crankshafts, of Siemens steel, 14½ inches diameter in the neck and 29 inches long, 15½ inches diameter in the body and 19 inches diameter at the wheel boss. The fly-wheel, which is 18 feet diameter and weighs 40 tons, is built up of eight rim segments and as many arms, which are held together and to the boss by cotters and bolts; the armature is bolted direct to the hub of the wheel, thereby avoiding strains in the shaft, and with the cranks and shaft brings up the total load on the two bearings to 70 tons. The governor is driven by ropes from the main shaft, and acts directly on the Corliss trip gear, as shown in our view of the high pressure valve gear. The crank chamber is completely enclosed, but there is no oil bath, lubrication being effected by means of a small pump worked by a link from the exhaust valve eccentric rod, which forces oil at a pressure of about 10 lbs. to all parts of the engine.

Car Shed.

For condensing purposes the air pumps will be driven by side levers from the crossheads of the engines, but these are not yet coupled up, though the air pump cylinders have been erected beside the main engine foundations. There are two pumps, each 24 inches diameter, with 12-inch stroke, to each of the larger sets.



1,000-h.p. Engine.—Low Pressure Valve Gear.

The 500-h.p. engines are generally similar to the larger sets, but are not at present completed. Their main dimensions are as follows:—Cylinders, 17½ and 33 inches × 36-inch stroke; piston rods, 3¾ inches diameter; crankshafts, 10½ inches diameter × 21 inches long in the neck, 12 inches diameter in the body, and 15 inches at the wheel bosses. Each of the smaller sets is provided with one air pump, worked from the main engine.

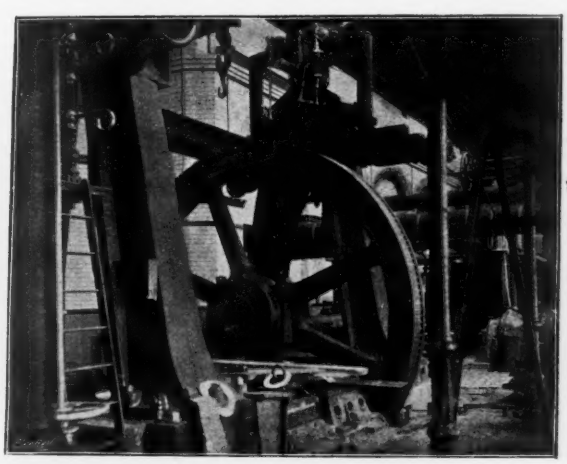
Between the engines, in the centre of the engine room, a gangway is erected from which access is obtained to the cylinders and valve gear of all the engines. The main steam pipes forming the doubled part of the steam ring are carried under and supported by the gangway, the floor of which can be lifted up to give access to the pipes. The main steam and exhaust valves can be operated from either the engine room floor level or the gallery. All the engines were built by Messrs. Musgrave and Sons, who guarantee the efficiency of the large engines to be 91 per cent. with the air pumps, and of the smaller 91 per cent. without them. The engines are also guaranteed to maintain constant speed within 2½ per cent. either way from the normal between full load and no load, while the speed can be varied by hand 5 per cent. either way while running. For starting purposes each set is furnished with a small barring engine made by the same firm.

Jet condensers are to be used, one to each engine, in conjunction with "Klein" cooling towers; the latter will be erected in a reservoir which is now being excavated for the purpose.

There is room for two more 1,000 h.p. sets in the present engine room, while the building can easily be extended, when necessary, in the direction of its length.

The generators coupled to the larger engines are rated at 600 kw. each, but will stand an overload of 25 per cent. for two hours continuously, and will be able to cope with fluctuations from 50 per cent. overload down to zero without injurious heating or sparking, and without shifting the brushes.

The field magnets are 12-polar, cast in four parts; the cores are hollowed in the yoke, and are without polar projections. The formers are made with heavy gun-metal flanges, those next the yoke being provided with lugs by which they are bolted to the yoke. The compounding coils are wound practically on the pole tips.



500-h.p. Engine in Course of Erection.

The armatures are of the toothed-core drum-wound type, and are provided with ventilating ducts; the windings, of copper bars, are interchangeable, and are easily removed and renewed. The commutators are 7 feet in diameter, and the cores 8 feet 6 inches in diameter, 21 inches long. Heavy

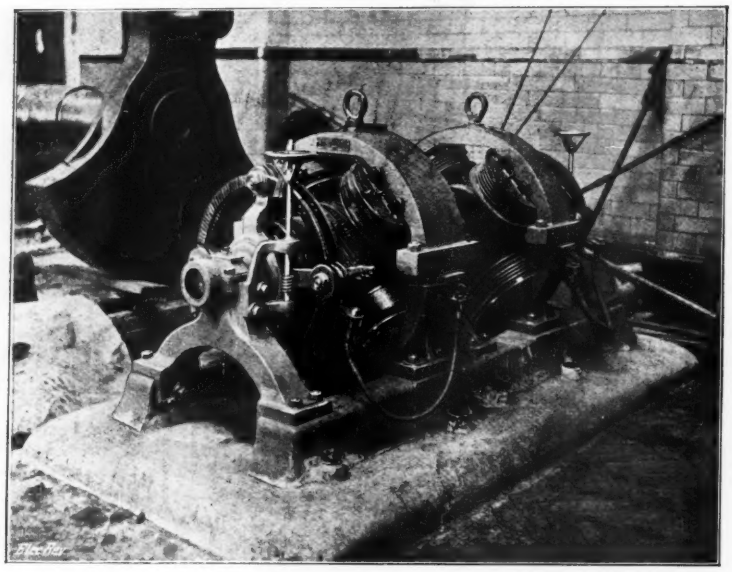
rings supported by brackets from the yoke carry 12 sets of carbon brushes, five in each set; these are adjustable simultaneously by means of screw gear.

The 300-KW. generators, which are constructed to fulfil the same conditions as the larger machines, are also 12-polar and of similar design. The armature cores are 7 feet diameter and 20 inches long, the commutators 6 feet diameter by 12 inches long. Barrel winding is used for the end connections and waved commutator lugs in all cases, and the polar clearance is very small.

The efficiency of the generators is guaranteed to be 94 per cent., and of the combined sets, 86 per cent.

All the generators were supplied by Messrs. Mather and Platt, of Salford, who also supplied the engines, and are responsible for the steam consumption guarantees, &c.

The new part of the engine room is traversed by a 20-ton crane, built by Messrs. Musgrave & Sons.



NEGATIVE BOOSTER.

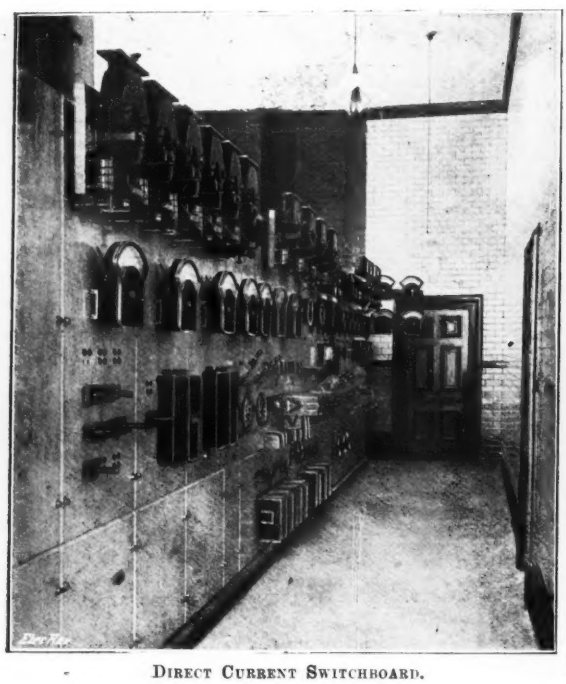
The new switchboard is situated behind the original lighting board, in a narrow room of which we give a view below. This part of the equipment was supplied by the British Thomson-Houston Company, Limited, and is practically of their standard type. There are 21 marble panels, two of these being at present to spare.

The four generating panels are fitted with heavy main throw-over knife switches, each with three blades; these are arranged for coupling in parallel, with equalising bar for traction, while, when the dynamos are required for lighting, the series winding is cut out of circuit. A main circuit-breaker is fixed on each panel, as well as a Weston ammeter reading to 2,000 amperes in the case of the larger generators, 900 for the smaller, shunt rheostat, and two Thomson-Houston watt-hour meters for lighting and traction respectively.

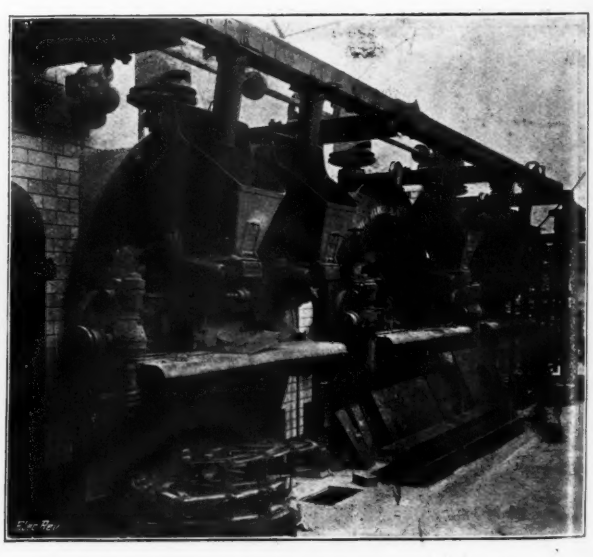
There are four feeder panels at the right-hand side carrying eight tramway feeders, each with ammeter and switch; one circuit-breaker is provided for each pair of feeders. Behind this part of the board are a number of huge "kicking coils" of bare copper and a bank of lightning arresters, and at the end of the board are four large illuminated-dial Weston voltmeters on hinged brackets, for lighting, traction, general use, and spare respectively.

At the left-hand side are three lighting panels, equipped for ± feeders and recording voltmeters; instead of fuses, a circuit-breaker is connected in series with each outer feeder, and the two are interlocked so that if one operates it trips the other also, and prevents excessive loading of the middle wire. This is rendered necessary by the fact that the distributing systems are kept entirely separate, and a three-wire feeder is run to each system.

In addition to the above there are two motor panels for the boosters, one positive and one negative booster panel, two balancer panels, a works' motor panel, and a Board of Trade panel. At the left-hand end of the board three illuminated-dial voltmeters, connected with the lighting feeders, are supported on movable brackets.



DIRECT CURRENT SWITCHBOARD.



BOILERS.

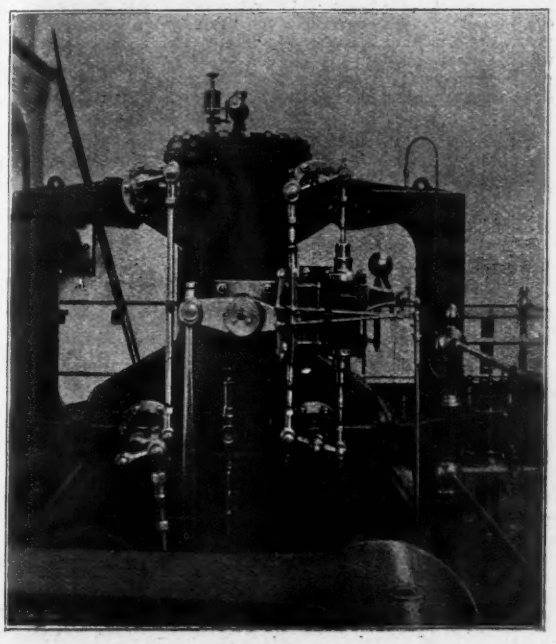
The two boosters, one of which we illustrate above, are placed near the lighting plant, and are of Messrs. Mather & Platt's four-pole type; they are used in connection with a long feeder on the Horwich route, one being in the trolley circuit, the other in a return feeder from the rails.

Coming now to the tramway system, there are at present 25 miles, all single track, in operation; the length will

shortly be increased to 31 miles. A double trolley wire is used throughout. The greater part of the overhead construction consists of side poles with brackets, though on three routes some span wire is employed. There are 10 different routes, all under three miles in length, except that which connects Bolton with Horwich, which is 6½ miles in length. The first 2½ miles of the latter route are supplied with power by a feeder direct from the works; the remainder is operated by means of a two-wire feeder, which runs straight out to a point 3½ miles from the works. At this point it is tapped into the trolley wire and the rails, and feeds both ways; it is for this feeder that the positive and negative boosters are required.

The whole of the track work and overhead construction was carried out by the British Thomson-Houston Company, with bonds and poles supplied by Messrs. R. W. Blackwell & Co.

The rails, which weigh 100 lbs. per yard, are carried in chairs on a 6-inch bed of concrete; the track is of standard gauge, and is estimated to cost £4,000 per mile, including paving with granite setts. A No. 0000 Chicago bond is used at every joint, together with a Plastic bond, and cross bonds are used at intervals of 80 yards. The trolley wire is divided into sections of half a mile, with feeder pillars at the section insulators. The poles are 31 feet in length over all, and are of three sizes, to stand a test stress, 18 inches from the top end, of 700, 1,000 and 2,000 lbs. respectively, with a tem-



1,000 H.P. ENGINE.—HIGH PRESSURE VALVE GEAR.

porary deflection not exceeding 6 inches, and 1,200, 1,700, and 2,600 lbs. respectively, with a permanent set not greater than ½ inch. The trolley wire is of No. 0 B. and S. gauge, and weighs 960 lbs. per 1,000 yards.

The tramway feeders are of the paper-insulated, lead-covered type, made by the British Insulated Wire Company, Limited, and are drawn into earthenware pipes. There are eight feeders to the trolley wire, and four return feeders.

The cars were supplied by Messrs. Dick, Kerr & Co., for whom they were made by the Electric Railway and Carriage Works Company, Limited, of Preston. There are 70 cars on order, of which 28 cars are already in operation, all of the double-deck type, seating 53 passengers each; they are mounted on motor trucks of the Brill type, No. 21 E, with a wheel base of 6 feet, and 30-inch wheels. Each car is equipped by Messrs. Dick, Kerr & Co. with two 30-H.P. Walker motors and controllers, with solenoidal blow-out and emergency brakes, and with the "Standard" air-brake of the same company. Several cars are shown in our view of the principal car depôt, which is at present 100 feet long, with eight trucks, but will eventually be 300 feet in length, and will accommodate 120 cars. There are three other car-sheds of smaller capacity on the longer routes, and extensive repair shops are to be erected.

The lighting system in the centre of the town is being converted from a three-wire 200-volt A.C. network to 460-volt direct current; the feeders are triple-concentric, paper insulated and lead covered, made by the British Insulated Wire Company, each of 0·8 square inch cross section, and are laid in earthenware troughs run in with pitch compound.

The progressive spirit in which electricity supply, whether for traction or lighting, is looked upon by the Bolton Corporation may be judged by the fact that sufficient land has been acquired about the present works to accommodate a total of 20,000 H.P.; the present extensions more than double the original size of the engine and boiler houses, and provision has been made for carrying out further extensions without modification of the general plan of the works.

We are indebted for facilities in preparing the above description to Mr. Arthur Ellis, who, as borough electrical engineer and manager of the tramways, has been responsible for the design and execution of the whole of this important scheme. We must also thank his assistants, Messrs. H. Angus, B. S. Hornby, A. T. Gordon-Smith, and F. Corson for their kind help on the occasion of our recent visit to the works. The weather at the time was exceptionally unfavourable to photography, and we were unable to obtain any views of the outdoor work; our thanks are due to Messrs. Gordon-Smith and Pownall, who very kindly placed a number of excellent photographs of the works at our disposal, from which we have selected many of those here reproduced.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 100.)

Totnes.—The Totnes Gas Company has lodged a petition with the Board of Trade against the application of the Totnes Electricity Supply Company for a provisional electric lighting order. The company recently endeavoured to induce the Town Council not to support the provisional order, but its communication was ignored.

Twickenham.—The District Council has received a letter from the Richmond (Surrey) Electric Light and Power Company, Limited, stating their intention to apply for a provisional order, and asking consent. They propose to supply current from the existing works at Richmond, thus obviating a delay in supply whilst works were being built. The letter was referred to the Lighting Committee. The clerk said that the Council had practically given consent to Edmundson's.

Worcester.—Mr. W. C. E. Meade King, Local Government Board inspector, held an inquiry on 16th inst. as to the application of the Worcester City Council for sanction to a loan of £4,000 for electric main extensions, meters, and indicators. There was no opposition.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—A special sub-committee has been considering the advisability of the County Council constructing a light railway from Aberdeen to Skene and Echt. Messrs. Walker & Duncan are to report upon the route and scheme in general along with the road surveyor. It is estimated that £2,000 per mile for construction, and £3,000 per mile for rolling stock, will be sufficient, making a total of £30,000.

On Monday night the electric car service was brought to a standstill through a defect in an underground feeder.

An electric tramcar collided with a timber-loaded wagon on the 9th inst. and was thrown off the rails, but fortunately no one was seriously injured.

Argentina.—The *Review of the River Plate* says:—

The City Council has given permission to the Anglo-Argentine Tramway Company to change its system of traction for that of electricity, and to alter some of its routes, but has added a rider to the effect that the electric traction is not to be put into service until the whole route has been illuminated. This means that the Anglo-Argentine Tramway will not convert its system, more especially when it has to hand over the entire system to the Municipality at the end of 99 years, free, gratis and for nothing. The New Council has shown itself to be about the worst with which this city has been cursed, and the sooner it is done away with by Congress the better, as it represents nobody's interests but its own, and it looks very carefully after these, to the detriment of those of the citizens.

Bury.—Messrs. Lacey, Clirehugh & Sillar have been retained to prepare a report on the proposed electric tramways scheme.

Bradford.—At the County Court last week Mr. Sam Ambler claimed £50 for damages to horse and trap from the Bradford Corporation, alleged to have been caused by negligent driving of an electric car. His Honour held that negligence was not proved, and gave judgment for the defendants.

Bristol.—At the last meeting of the Sanitary Committee the engineer reported that he had received an application from the Bristol Tramways and Carriage Company, who had been required by the Committee to place centre poles at that part of West Street lying between Cannon Street and Albert Road, asking to be relieved from the engagement and allowed to substitute span wires, as in three cases out of five centre poles would come on top of a large water main. The application was granted. The engineer then reported that he had had an interview with the secretary of the Bristol Tramways and Carriage Company, and laid before him the reasons why the Committee considered that the company should lay with wood paving at their cost the whole of the surface of the carriage way of Lawrence Hill Bridge and of the approaches to be widened. But that gentleman stated that the directors considered that they should not be asked to pay for a greater width than that occupied by the lines, the middle space and the margins, equal in all to 19 feet, and that they declined to reconsider the committee's request to pave the remaining 21 feet. Consideration was deferred.

Cheltenham.—The Light Railway Commissioners held an inquiry on 12th inst. into the application of Mr. T. Nevins to construct an electric railway through the streets of the borough. Mr. G. A. R. Fitzgerald presided. In opening for the promoter, Mr. Hutchinson gave a *résumé* of previous applications, remarking that they had been made on two other occasions for the construction of a railway practically the same as this, except a few alterations in the line of route, but they had failed through technical objections. In June of last year it was brought forward again, and the section of the railway was not sanctioned because of a clause in a certain deed of covenant. He proceeded to deal with the line of route, remarking that the streets were of ample width throughout. With regard to the estimate of expenditure, he pointed out that the Commissioners on the last occasion sanctioned 3½ miles with a capital of £36,000, and the amount of capital he asked to be added was £21,000. The actual cost was estimated at £20,430, the cost of construction of this portion being a little less per mile. There was practically no opposition to the railway itself or the policy of construction. Mr. Pritchard, engineer of Birmingham, was then called, and gave evidence as to the construction. He had personally examined the whole of the route, width, and gradients, and, generally speaking, the projected route was most favourable for a railway of this kind. It was the one that the least objection could be made to of all he had inspected for the past 35 years. The most severe gradient was 1 in 35, but this occurred in a wide road and not on a curve. As to the curves, he pointed out the minimum would be 40 feet. The Commissioners will report to the Board of Trade in due course.

Constantinople.—A Berlin syndicate is said to be about to send a delegate to Constantinople to petition the Ministers of Commerce and Public Works for a concession for an electric tramway at Constantinople.

Dublin.—There was a stoppage of the electric car service on 11th inst., "a defect in the steam pumps under exceptional conditions" at the power station being blamed.

Elland.—It will be remembered that the District Council demanded power to supply the electric current for the Halifax trams when in their district, but the Halifax Tramways Committee now refuse such a concession. The Tramways Committee suggested that they should establish a local electricity station at Elland, and they would be willing to supply the current in bulk to Elland, at the rate of 2¾d. per unit. Whether the Elland Council will oppose the Halifax Parliamentary Bill has not been settled, and it is expected that a town's meeting would veto such a proceeding.

Kirkcaldy.—The Tramways and Electric Lighting Committee having considered the report of Mr. John Young, of Glasgow, on the offers of the English Industrials Company, Edmundson's Electricity Corporation, Drake & Gorham Electric Power and Traction Company, and the British Electric Traction Company *re* combined lighting and traction schemes has decided to have a personal interview with Mr. Young.

Leeds.—On 16th inst. a deputation of members of the Corporation Tramways Committee visited Sheffield for the purpose of inspecting the electric system.

Madras.—It is stated that the Madras Government, on being referred to by the president of the Madras municipality regarding the proposed purchase by the municipality of Madras of the electric tramways, has objected to the municipality raising the necessary loan of 15 lakhs of rupees on security of the rates and taxes as the present loans are considered to be as much as ought to be raised on this security.

Peterborough.—The Light Railway Commissioners will hold an inquiry at Peterborough on Friday, January 26th, regarding the application of the British Electric Traction Company for powers to construct light railways in Peterborough and district.

Potteries.—The motor men and conductors of the Potteries Electric Traction Company have asked for shorter hours and longer pay.

Rhondda.—Mr. H. S. Fitzgerald and Colonel Boughey, R.E., sat at Pontypridd on Thursday last week to inquire into the proposal of the British Electric Traction Company, Limited, to construct a light railway from Tonypandy to Pontypridd and Cilfynydd. Mr. Sydney Morse, London, appeared for the promoters, and Mr. S. T. Evans, M.P., supported on behalf of the Pontypridd District Council. Opposition was offered by the Taff Vale Railway Company, the borough of Cardiff and the Rhondda District Council, the Glamorganshire Canal Company, the Pontypridd Waterworks Company, and the Glamorgan County Council. Mr. Morse explained that the promoters would not require the Taff Vale Railway Company's land on the side of the Cilfynydd Road, as they had now arranged to take their electrical energy from the Pontypridd District Council. The promoters would also agree to take the railway through Market Square, Pontypridd. Mr. Stephen Sellon, the company's engineer, said he estimated the cost of the railway at £36,932. He proposed widening Mill Street, Pontypridd, on the north side and, according to the requirements of the Pontypridd District Council, he estimated the cost at £7,000; but, learning that he could widen the south side at an estimated cost of £4,500, he decided to widen that side. The inquiry was subsequently adjourned *sine die*.

St. Helens.—A special meeting of the Town Council was held on Saturday for the adoption of certain recommendations of the Parliamentary Committee relating to the South Lancashire Electric Tramway scheme, &c. The committee approved of the scheme, subject to certain conditions for the protection of the interests of the Corporation, and recommended that a deputation be appointed to attend the conference called by the Lord Mayor of Manchester for an expression of opinion in regard to the Lancashire Electric Power Bill. Alderman J. C. Gamble, in moving the adoption of the minutes, remarked that they had decided not to oppose the schemes, because the first would be the means of bringing tramways from Manchester, through St. Helens, and really on to Liverpool; while in regard to the other scheme, they came to the conclusion that if the promoters could supply cheaper power than the Corporation, the latter could use it, and thus bring manufactories into St. Helens, which otherwise might remain outside. The committee did not agree to any proposals which would have the effect of preventing the extension of electrical power throughout the country. The minutes were adopted.

Sheffield.—A defective cable in one of the switch boxes on the Walkley tram route was responsible for the cutting out of the part of the system for about 45 minutes on Monday afternoon.

Southampton.—The Board of Trade has approved of the Shirley electrical section. Mr. Trotter's report to the Board said:—

> The overhead trolley system is used with swivel trolleys, but with a practically centre running trolley wire. A temporary generator and engine had been provided, but the bearings of the generator gave trouble on the day before the inspection, and two dynamos intended for lighting were coupled together temporarily. Provision is being made for extension of the generating plant and for a large battery. The electrical equipment of the line is satisfactory. The engineer agreed, pending further inspection, to a speed of six miles an hour east of Albert Road, and eight miles an hour to the west of Albert Road.

It is stated that the labourers employed in laying the new rails for the electric trams at Southampton went out on strike on 11th inst. Work is at a standstill. The men wanted a half-penny more an hour. The contractors refused to entertain the demand.

South Lancashire.—The comprehensive electrical tramway scheme for South Lancashire has been deposited in Parliament, and has passed the Examiner on Standing Orders. It affects 18 different authorities, and the route covered will exceed 70 miles. The capital will be £1,100,000 in £10 shares. The system comprises a perfect network of lines between St. Helens and Manchester, and must be completed within four years of the passing of the Act. The route will be lighted by electricity, and waiting rooms will be provided.

The Metropolitan and Electric Traction.—The District Railway Company has deposited a Bill for next session asking for powers to construct a generating station at Chelsea in furtherance of the scheme for working the line by electricity. The company also asks for leave to work by electricity on its own lines and on the lines of the Metropolitan Company over which the District has running powers. Provision is sought for the mutual supply of electricity, under agreement, between the Metropolitan, the District, and the Brompton and Piccadilly Circus Railway Companies.

Wellingborough.—The Bill under which the British Electric Traction Company are endeavouring to obtain powers for the construction of their circular tramway through the Wellingborough, Rushden, and Finedon district, has just been issued.

Whitehaven.—The Town Council has given a general sanction to the electric tramway scheme of the English Industrials, Limited. It appears that the company will take its supply of energy for the trams from the municipal electricity works.

Worcester.—The Streets and Electricity Committee has found it impossible to come to terms with the promoters of the electric tram scheme, and it was to oppose the application of the British Electric Traction Company, which formed the subject of a Light Railways inquiry on Wednesday.

At a meeting of the inhabitants of St Peter's Ward on 15th inst., a resolution was passed favouring the introduction into the city of electric trams and the provision of light railways in the surrounding districts.

Wolverhampton.—Our local correspondent writes:—"Great dissatisfaction is being expressed with regard to the progress—or rather lack of progress—that is being made with the new tramway scheme. Several months have elapsed since the public were informed that the necessary powers had been acquired for the purchase of the present company's system, and the carrying out of the new scheme which the Corporation had planned for extending that system on improved lines, so as to afford easier and more rapid means of communication between the town and surrounding suburbs than is now provided by the slow-going and old-fashioned horse tram and 'bus, yet no practical move seems to have been made by the Corporation towards the accomplishment of their desired object. Mr. F. Bramwell, the appointed arbitrator by the Board of Trade, was to have visited Wolverhampton for the purpose of settling the amount to be paid by the Corporation to the Wolverhampton Tramways Company on taking over the present line of rails, tramcars, and other plant, but the date of that visit has not yet been fixed. In the interval, however, there must be a great number of matters of one kind and another, such, for instance, as the selection of expert witnesses to be called before the arbitrator on behalf of the Corporation, the acceptance of tenders for the new rails and other plant required, which might fairly be considered; yet, strange to say, no meeting of the Tramways Committee for real practical business has been held for nearly three months. The fact that no apparent progress is being made with the new scheme is causing much unfavourable comment."

TELEGRAPH AND TELEPHONE NOTES.

Bath Telephones.—By the new agreement between the Council and the National Telephone Company *re* the laying of the lines and the erection of posts the Council will receive 10s. for each pole the company put up, and 2s. for each subscriber. They would have the same control of the roads as formerly, and it is thought that much trouble previously experienced would be saved in the future.

France and Submarine Cables.—The *Standard* Paris correspondent says:—"The censorship which has been exercised by the British authorities on telegrams from South Africa since the outbreak of hostilities there seems to have awakened France to the inconveniences which might result to her in case of war from the virtual monopoly of the submarine cables being in the hands of the English. A Bill has been presented to the French Chambers for the laying of certain cables which would doubtless make France to some extent independent of the English in so far as some of her colonies are concerned. Nevertheless, those lines of telegraphic communication have not yet emerged from the phase of project, and in the meantime it is pointed out that the British network of submarine cables encircling the world measures already 250,000 kilometres. It is, moreover, proposed to add yet another link to this chain by connecting Canada with Australia by a cable across the Pacific Ocean. It is a curious fact that the little the French have done in the way of cable-laying is not of a nature to further what may be called the Imperial interests of the country. They possess the longest existing submarine cable. It is that from Brest to Cape Cod, and from there to New York. With its prolongations to the West Indies and to South America, that line of telegraphic communication measures no less than 23,500 kilometres. But France has no very important colonies in those regions. A French cable places Madagascar in connection with Mozambique, but that country has no telegraphic communication with Europe except by the English lines. It is the same with regard to New Caledonia. To communicate with their colonies in West Africa and in Indo-China, the French must employ the British network of cables and telegraphic lines, which, even when passing over foreign territory, are in connection with none but the telegraphic offices of the English companies, which are constrained by their contracts to employ none but English telegraph clerks. The *Débats* points out that this state of things is very dangerous to France because, in the event of a declaration of war, the British Company would surely refuse to transmit messages from France, though she pays annual subventions amounting to 2,337,000 francs to the English companies for her telegraphic service with West Africa and Indo-China. With the object of modifying this state of things to the advantage of France, this journal contends it would be easy to connect Tonquin with the Russian Asiatic telegraphic lines, and it urges the Government to take effectual measures for the creation of French telegraphic lines and cables connecting France with both the western and eastern coasts of Arica, extending on the one side as far as the French Congo and on the other as far as Madagascar."

Press Telegrams between France and the United Kingdom.—The Foreign Office issued on Tuesday the text of the agreement concluded between the French Foreign Minister and Her Majesty's Ambassador in Paris on November 8th last for the reduction of rates on Press telegrams sent between 6 p.m. and 9 a.m. The reduction amounts to 50 per cent., the minimum charge, however, being 1f., or 10d.

Telegraph Rates to India.—The *Times* Calcutta correspondent writes:—"In connection with the agitation in England in favour of cheapening telegraphic communication between Europe and India, the *Pioneer* advocates the construction of a line linking Quetta and Meshed, *vid* Seistan. The Government are already laying a wire from Quetta to Nashki, along the new trade route to Central Asia, which has proved such a success. Meshed is linked with Teheran by the Persian telegraph, while the nearest point on the Russian lines on the Trans-Caspian Railway is only 90 miles distant from Meshed."

Telephone Call Office.—It was reported at the last meeting of the Clerkenwell Vestry that the National Telephone Company had written asking whether the Vestry had a space in any of their pavements upon which they would be willing to allow the company to erect a public telephone call office. But the Works Committee, who considered the matter, recommended that a reply be sent that the Vestry have no place available for such purpose.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired
WEST INDIES:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
SOUTH AFRICAN:—		
Zanzibar-Mombasa	Oct. 26, 1899	Jan. 13, 1900
Mozambique-Lourenço-Marques	Dec. 17, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Tarifa-Tangier	Jan. 3, 1900 ...	...
Iquique-Valparaiso	Jan. 10, 1900 ...	...
Serena-Valparaiso	Jan. 16, 1900 ...	...
Landlines.		
WEST INDIES:—		
Communication with Les Cayes (Haiti)	Nov. 21, 1899 ...	...
SOUTH AFRICAN:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with Colombia ...	Nov. 3, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 10, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Jan. 13, 1900	Jan. 15, 1900.

The Pacific Cable.—After making quotations from the chief organs of the present Canadian Cabinet, and of the opposition, our well-informed contemporary, the *Outlook*, writes as follows:—

These authoritative Canadian journals talk of "mysterious influences" at work, and a Canadian of high position and authority, writing from Ottawa to the *Canadian Gazette*, declares, truly enough, that "this is not the time to trifle with the Colonial people, when they are sending successive contingents to South Africa."

Now, for these complainings the Pacific Cable Board and the Colonial Office have only themselves to blame. Here is a vital Imperial matter—how vital has been proved once again in this South African crisis by the imminent peril of a total breakdown in cable communication with the seat of war. In this vital Imperial matter the Colonies, more alert than we to Imperial needs, have led the way with splendid persistence and even generosity. Yet all Downing Street can do is to act as a heavy drag on the coach. It is the more unfortunate that this should be the official attitude because it happens that at this moment one of the temporary heads of the Colonial Office is himself a director of the Cable Group. A mere coincidence it may be—we do not suppose that Sir Robert Herbert is in any way responsible for the delay—but no one can measure the bad impression such a coincidence must create in Canada and Australasia, coming as it does on the top of a long series of delays difficult to explain except on the assumption that the great cable monopoly, which Sir John Pender spent his life to create and preserve, has far more influence in English public life than is good for the Empire.

The *British Australasian* publishes a despatch dated Sydney, December 8th, stating that "A conditional arrangement has been come to between the Postmaster-General and the Eastern Extension Telegraph Company for the extension of the present contract till the completion of the Pacific cable. If the Cabinet approved of the agreement, it will come before Parliament for ratification."

Wireless Telegraphy in the Navy.—It is stated that a number of signalmen and torpedo-men of the Channel Fleet have joined temporarily the Vernon Torpedo School at Portsmouth for instruction in wireless telegraphy, as the system is to be installed on the *Majestic*, *Magnificent*, *Hannibal*, and *Jupiter*, belonging to the Channel Squadron.

CONTRACTS OPEN AND CLOSED.

Aberdeen. — January 22nd. The Electric Lighting Committee wants tenders for a 420-KW. direct coupled continuous current dynamo. See "Official Notices" January 5th.

Barking.—January 23rd. The Urban District Council wants tenders for two continuous current transformers and switchgear, underground cables and roadworks for the Creeksmouth electric lighting extension. See "Official Notices" December 29th.

Bath.—February 12th. The Corporation invites tenders for high and low tension cables, arc lamps and posts, transformers, and sub-station and main works' switchboards. See "Official Notices" to-day.

Beira. — The Companhia de Mocambique is inviting tenders for laying down plant for electrically lighting the town of Beira (Portuguese East Africa) and for working same for 25 years. See "Official Notices" January 5th.

Belfast.—February 8th. The Electric Committee wants tenders for 400-KW. steam dynamos. See our "Official Notices" January 5th.

Bradford.—February 3rd. The Tramways Committee is inviting tenders for the complete electrical overhead equipment of about eight miles of tramway. Specifications, &c, at the City Surveyor's office, Town Hall, on payment of £3.

Germany.—January 24th. The Prussian State Railway authorities at Frankfort-on-Maine, are inviting tenders until the 24th inst., for the supply of 270,000 arc lamp carbons. Particulars may be obtained for 6d. from, and tenders to be sent to, Die Königliche Eisenbahn Direction, Frankfort-on-Maine.

Glasgow.—January 24th. The Corporation invite offers for supplying and erecting electric motors and shafting for laundry machinery, as also electric motors and shafting for mechanical stokers, elevator, and conveyor, required at Ruchill Fever Hospital. Specifications at the office of Public Works, City Chambers, 64, Cochrane Street.

Glasgow.—January 29th. The Corporation invites tenders for the supply and fitting up of a hydraulic or electric lift. Plans and specifications on application to Mr. Thomas Young, consulting engineer, 4, West Regent Street, on payment of a fee of £1 1s.

Great Yarmouth.—February 15th. The Corporation wants tenders for two water-tube boilers and three 200-KW. continuous current steam dynamos. See "Official Notices" to-day.

Hull.—January 24th. The Electric Lighting Committee invites tenders for 30 cast-iron section pillars each containing eight switch fuses, &c. See "Official Notices" January 12th.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" December 15th.

Keighley.—February 3rd. The Corporation wants tenders for two Lancashire boilers, mechanical stokers, economisers, feed pumps, one 120 and one 200-KW. high speed continuous current steam dynamos. See "Official Notices" to-day.

The Council has approved of plans for electricity offices and battery room, at a cost of £5,000, and of boilers, engines, and dynamos, at a cost of £7,510—total £12,510.

Leyton.—February 14th. The Electric Lighting Committee wants tenders for a switchboard for the new electric light works. See "Official Notices" to-day.

London.—February 5th. The Postmaster-General is inviting tenders for underground work, including laying conduits and pipes for telephone purposes in several parts of the metropolis. See "Official Notices" this week.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

Newcastle-on-Tyne.—January 24th. The Corporation wants tenders for laying down about 11 miles of double line tramway, the rails, fastenings, and the poles being supplied by the Corporation. See "Official Notices" December 22nd.

Plymouth. — January 31st. The Corporation wants tenders for a 500-KW. steam dynamo (motor generators, &c.); a 500-KW. steam alternator, &c.; accumulators; Lancashire boilers and equipment; mains. See "Official Notices" January 5th.

Sheffield.—January 20th. The Electric Lighting Committee invites tenders for steam and exhaust pipes and jet condenser for the electricity works. See "Official Notices" January 5th.

Spain.—January 26th. Tenders are being invited, until the 26th inst., by the municipal authorities of Astudillo (province of Pallacia), for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Astudillo (Valencia), whence particulars may be obtained.

Spain. — January 27th. The municipal authorities of Porcuna (Jaen province) are inviting tenders until the 27th inst., for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from El Secretario del Ayuntamiento de Porcuna (Jaen) to whom tenders are to be sent.

Spain.—Tenders are invited by a company called "El Porvenir de Zamora" in Spain for the supply and erection of three-phase alternators complete with exciters, switchboards, &c., for electric light, transmission of power, traction and other purposes at "El Porvenir" in the district of S. Roman de los Infantes.

Motive power will be obtained from two "Hercules-Progrés" turbines with vertical axis, each of 500 H.P. working at a normal speed of 200 revolutions per minute. These turbines are manufactured by Messrs. Singrün Brothers, at Epinal (France). No particular system of alternator is specified (except, of course, that they must be coupled direct to the turbine shaft) but it is suggested that the periodicity should be 50 per second and the E.M.F. 5,000 volts *at least*. It is stated that provision must be made for a fourth wire for lighting purposes.

The company proposes in the future to erect five more alternators of 900 H.P. each, and provision must be made for the control of these in designing the main switchboard, but at the moment only those instruments relating to apparatus to be erected now, are to be mounted.

Contractors will specify what efficiency they are prepared to guarantee, but this must in no case be lower than 90 per cent. ($\cos \phi = 0{\cdot}80$).

Contractors must also fix the power to be absorbed by the exciter, for the production of the required exciting current and E.M.F. for the alternator. The internal resistance of the armature cold, and at the temperature corresponding to full load is to be stated. This latter, after six hours' run at full load, is not to exceed 40° C. (72° F.) above that of the surrounding air.* The material used for insulation must be *absolutely unaffected by a temperature of* 100° *C.* (212° *F.*) *for an indefinite period.*

The methods to be adopted by the company for verifying the efficiencies guaranteed by the contractor is as follows:—

First, the energy yielded by the turbines will be determined by a transmission dynamometer of the best known type, and compared with the electrical output of the alternators.

Secondly, each of the alternators will be used to work the other as a motor, the efficiency being determined in the usual way.

The lower efficiency thus obtained will be taken to be the efficiency for the purposes of the contract.

All measuring instruments for the trials are to be furnished by the contractors.†

The contractors are to submit with their tender complete plans, elevations, and sections of the installation as they propose to erect it. Also a drawing to scale, showing the disposition of all the plant and machinery and apparatus. Further, they are to give a complete description of the alternators, and complete calculations showing how the dimensions of the electrical, as well as the mechanical portions are arrived at.

The conditions under which the work is to be carried out contain the following provisions:—

The insulation of all conductors is to be tested at a pressure double that corresponding to normal conditions at full load (this voltage would be 10,000).

All rubbing surfaces‡ are to be so calculated and arranged as to work *without the slightest heating.*

No portion of the machinery is to be erected without having first been examined by the director of the company or his delegate, and pronounced free from defect. *Nevertheless the responsibility of the contractor shall in no wise be relieved thereby.*

The alternators are to be delivered by September 30th, 1900, under a penalty of £8 per alternator per day.

The company will "provisionally" accept the plant within three months of the date of starting, providing all the conditions and tests prescribed in the specification are satisfactorily carried out. The contractor must give a guarantee against defective material for one year after the provisional acceptance.

Tenders are to be forwarded in sealed envelopes to the director of the El Porvenir di Zamora Company, on or before January 30th, 1900.

Various penalties attach to a lower efficiency on test than that guaranteed, and various privileges and rights are reserved by the company to provide for such contingencies, but it is difficult to see how a specification so loosely worded as this one, could result in anything but chaos. We should think that the only people who are likely to get any tangible profit out of a contract entered into on such terms would be the arbitrators, as the only clause which could not give rise to dispute later on seems to be the last one, which is the usual arbitration clause. It is to be hoped that the company has plenty of funds, and of water-power, then there is every likelihood of plenty of fun.

Stoke-upon-Trent. — February 13th. The Guardians want tenders for the electric lighting of a portion of the workhouse premises. See "Official Notices" to-day.

Sunderland.—The Corporation wants tenders for a tramways switchboard. See "Official Notices" January 12th.

Tunbridge Wells.— January 25th. The Corporation wants tenders for a 400-KW. steam alternator. See "Official Notices" January 5th.

Tunbridge Wells.—February 5th. The Corporation wants tenders for the supply of two Lancashire boilers for the electricity works. See "Official Notices" to-day.

Tynemouth. — January 31st. The Corporation wants tenders for 12 electricity meters. See "Official Notices" to-day.

West Hartlepool.—January 23rd. The Corporation invites tenders for wiring and fitting the public library for electric lighting. Specifications, &c., from the borough electrical engineer, H. F. Friedrichs, electric light station, Burn Road, on payment of £1 1s.

CLOSED.

Accrington.—The Council has accepted the tender of Messrs. W. T. Glover & Co. for electric light cables. This is the contract, mentioned last week, which is costing £1,400 or £1,500 in excess of what the cables might have been obtained for if there had been no delay in placing the order.

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* Nothing is said as to the method to be adopted of determining the temperature of the armature.

† Nothing is said as to calibration of these instruments.

‡ It is not clear whether this refers to bearings or switch contacts, possibly it is intended to include both.

Birkenhead.—The Corporation has ordered 13 single-deck and 31 double-deck electric motor cars from the B.T.H. Co. for £28,866.

Gloucester.—In our last issue we mentioned the accepted tenders for extension plant for the electricity works. We are now able to publish the following complete list of the tenders received, and reported upon by the Corporation's consulting engineer, Mr. Robert Hammond :—

SECTION A.—BOILER HOUSE PLANT.

	£	s.	d.
E. Danks & Co. (Oldbury)	940	0	0
R. Taylor & Sons	950	0	0
Tinkers, Limited (*accepted*)	955	0	0
E. Chester & Co.	959	0	0
Dutilh, Smith, McMillan & Co.	959	10	0
Yates & Thom	1,010	0	0
Tetlow Bros.	1,040	0	0
G. K. Stothert & Co.	1,256	0	0

SECTION B.—ENGINE HOUSE PLANT.

	Maker of engine.	£	s.	d.
Dutilh, Smith, McMillan & Co.	Paxman	3,140	0	0
Ernest Scott & Mountain	Own	3,750	0	0
Ashton, Frost & Co.	Willans	3,985	0	0
Mather & Platt (*accepted*)	Willans	3,984	0	0
Easton, Anderson & Goolden	Own	4,098	0	0
India-rubber G. P. and T. Works Co.	Willans	4,110	0	0
Johnson & Phillips	Willans	4,190	0	0
India-rubber G. P. and T. Works Co.	Belliss	4,250	0	0
Crompton & Co.	Willans	4,358	0	0
Mather & Platt	Belliss	4,484	0	0
Electric Construction Co.	Willans	4,5·0	0	0
Crompton & Co.	Belliss	4,740	0	0
Electric Construction Co.	Belliss	4,752	0	0
E. Chester & Co.	Own	4,912	0	0
Brush Electrical Engineering Co.	Belliss	5,002	0	0

SECTION C.—SWITCHBOARD EXTENSION.

	£	s.	d.
Electrical Transmission Co.	210	0	0
Crompton & Co.—(*accepted*)	251	0	0
Electric Construction Co.	270	0	0
Edwards Electrical Co.	280	0	0

SECTION D.—CONDENSING PLANT.

	£	s.	d.
E. Chester & Co.—(*accepted*)	493	0	0
Klein Engineering Co.	536	0	0
Dutilh, Smith, McMillan & Co.	538	0	0
Blake & Knowles Steam Pump Works	552	0	0
Ashton, Frost & Co.	590	0	0
Worthington Pumping Engine Co.	618	0	0
Mirrlees, Watson & Yaryan Co.	660	0	0
Middleton Engineering Co.	759	1	7

London.—The Bermondsey Vestry on Monday referred to the Electric Lighting Committee for consideration and report the following tenders received for the supply and erection of a refuse destructor in connection with the proposed electric light station :—

		Alternating tender providing for smaller boilers.
Manlove, Alliott & Co., Nottingham	£11,300	£10,444
W. F. Mason, Limited, Manchester	6,123	5,914
Horsfall Destructor Company, Leeds	11,952	11,116
Heenan & Froude, Manchester	7,400	7,000
Hughes & Stirling, Liverpool	10,242	9,562
Samuel Willoughby, Bristol	6,250	5,850
J. Baker & Sons, Willesden	8,199	7,809

The Vestry is recommended to accept the tender of the National Electric Wiring Company for the supply of three electroliers for the board room for £37 6s., and for an electric-motor fan for ventilating purposes for the sum of £48 15s.

London.—The Battersea Vestry have accepted the tender of Messrs. J. and A. Law, amounting to £3,126, for the supply of electric arc lamp-posts according to Specification No. 9, and that of Messrs. Callender's Cable and Construction Company for the laying of spare stoneware ways for future feeders, at an estimated cost of £1,500.

London.—The Metropolitan Asylums Board has ordered electricity meters from Messrs. Siemens Bros, and wall plug covers from Hayward, Tyler & Co.

FORTHCOMING EVENTS.

Thursday, January 25th.—At 8 p.m. The Institution of Electrical Engineers. Adjourned Discussion on the Report of the Institution's Visit to Switzerland; and, if time permit, "An Electrolytic Centrifugal Process for the production of Copper Tubes," by Sherard Cowper-Coles, member.

Friday, January 26th.—At 5 p.m. Physical Society. 1. "Some Developments in the use of Price's Guard Wire in Insulation Tests." By Prof. Ayrton and Mr. Mather. 2. "Reflection and Transmission of Electric Waves along Wires." By Dr. E. Barton and Mr. L. Lownds. 3. "The Frequency of the Transverse Vibrations of a Stretched India-rubber Cord." By Mr. T. J. Barker.

At 8 p.m.—Electro-Harmonic Society's smoking concert (patriotic night), Café Monico, Regent Street, W.

At 9 p.m.—Royal Institution. The Hon. C. A. Parsons on "Motive Power, High-Speed Navigation, Steam Turbines."

Saturday, January 27th.—Institution of Junior Engineers' Anniversary Dinner at Westminster Palace Hotel.

Friday, February 2nd.—Royal Institution. Mr. G. Marconi lectures on "Wireless Telegraphy."

Institution of Junior Engineers. Paper on "Arc Lamps and Arc Lighting," by H. G. Cotsworth.

NOTES.

Glasgow Electrical Engineers.—A petition addressed to the Institution of Electrical Engineers by 70 gentlemen engaged in electrical industries in Glasgow for the formation of a local section of the Institution, with its headquarters in Glasgow, has just been granted. A meeting was to be held in the Hall of the Philosophical Society, 207, Bath Street, on Thursday (yesterday evening), to arrange for the formation of the section, and to appoint a provisional committee to draft local rules and to carry on the work of the section till May. Dr. Magnus Maclean, Professor of Electrical Engineering in the Technical College, has taken a leading part in the movement.

Prof. Fleming on Ether and Atoms.—At the London Institution on Monday, Prof. J. A. Fleming gave a lecture on "Ether and Atoms." We read in the *Times* report that, remarking that among the achievements of philosophic thought in the 19th century a high place must be given to speculations on the existence of an ether filling space, he gave a brief sketch of the rise of the undulatory theory of light, and, as a second stage in the development of the ether theory, of the conception of an electro-magnetic medium. As a consequence of the system set forth in Clerk Maxwell's epoch-making paper in 1864, the existence of electric waves was deduced, though no one at that time had made them, much less detected them, and Maxwell prophesied they would have the same speed as those of light. In 1879, eight years after his death, an experimental way of verifying these predictions was discovered by Hertz; his waves were some 30 feet long, but they had since been obtained so small as $\frac{1}{8}$th of an inch. Prof. Fleming described Hertz's method of detecting the existence of these waves and also that afforded by the "coherence" of metallic filings, discovered by Hughes in 1879, and afterwards rediscovered by Branly, mentioning its application by Marconi to the purposes of wireless telegraphy. Speaking of the constitution of this all-pervading ether, the lecturer said the chief thing we knew about it was its power of taking up enormous quantities of energy, though what became of the energy thus sunk in it we did not know. As to the nature of its mechanical properties, it had elasticity which was probably not of the two kinds with which we were acquainted, viz., bulk elasticity, as of a compressed gas, and the elasticity of elastic solids, as of a steel spring. Coming to recent ideas as to atoms, the lecturer pointed out that Lord Kelvin and others of late years had approached some conception of their dimensions. But even if it were possible to improve the microscope so as to render visible things of the size of atoms, yet they could not be seen, for to be seen they must be still. But, in fact, they were in very rapid motion, a hydrogen atom, for example, going a mile a second, while the velocity of the atoms in solid bodies was probably not of a very different order. In conclusion, he referred to the recent work of Prof. J. J. Thomson, which seemed to show that chemical atoms were not the smallest objects with which we could be acquainted, and that they could be split up into parts something like a thousand times smaller—a condition in which they formed, in Sir W. Crookes's phrase, "a fourth state of matter."

Institution of Junior Engineers.—Last night a lecture on "The Balancing of Engines" was delivered at this Institution by Prof. W. E. Dalby.

Lectures.—A special course of lectures on "Polyphase Machinery" is being given at Messrs. Crompton's works at Chelmsford, by Mr. A. C. Eborall. The first lecture was delivered on Monday night last, January 15th, and the other six follow on consecutive Monday evenings. We have received a copy of the syllabus of these lectures.

A course of 10 lectures on the "Direct Current Motor" is to be delivered at the South-Western Polytechnic, Chelsea, on Mondays, commencing January 22nd, by Prof. C. A. Carus-Wilson. For particulars see a notice among our advertisements.

On 12th inst., at the Bradford Church Institute, Mr. Pringle, the superintendent of the city tramways, gave a lecture to the members of the Bradford Scientific Association on "Electric Traction."

Under the auspices of the Liberal and Conservative Associations of the Spinneyhill Ward, a lecture was given at Leicester last week by Mr. Alfred Colson, manager of the Corporation gas and electric lighting works, on the "Development of Electricity as an Illuminant," the proceeds being devoted to the fund for the families of Leicester reservists called out for active service.

Before the Ipswich Engineering Society on Monday, Mr. W. Reavell read a paper on "Compressed Air and Pneumatic Tools." Among many other matters, he described an electrically-driven air compressor of his own invention.

Personal.—Mr. J. Hardie McLean has severed his connection with the firm of W. Lucy & Co., Limited, iron founders, Oxford.

Mr. W. M. Mordey has arranged to take into partnership Mr. R. A. Dawbarn, who has just given up his post as superintending engineer to the Brush Company. Most people in the electrical engineering profession know Mr. Dawbarn as a very highly experienced engineer in all matters connected with the preparation, planning, and carrying out of all kinds of electrical undertakings, for lighting, power and traction. Mr. Mordey has a still longer record, and probably no one is held in greater esteem. We wish the new firm of Mordey and Dawbarn every success, and if honesty of purpose and strict integrity are any criterion they will achieve it.

Mr. A. H. Rice writes correcting last week's notice that he had been appointed chief engineer at *Bury*. As a matter of fact, he has been appointed borough electrical engineer to the Corporation of *Bury St. Edmunds*, Suffolk, and will take up his new duties very shortly. It is hoped that supply will commence in March.

It is announced that a marriage has been arranged to take place on Tuesday, February 27th, at Rajkot, Bombay Presidency, between Mr. Stephen Babington, assistant superintendent of telegraphs, and Miss Ada Hawes, daughter of Mr. C. Hawes, late I.C.S.

Mr. J. J. Smith, chief assistant engineer at the Altrincham Electric Supply Company's works, who has just been appointed borough electrical engineer to the Stockton Corporation, dined with a number of his fellow employés in the Town Hall, Altrincham, some days ago. During the evening Mr. Smith was the recipient of a present from his colleagues.

With reference to a note appearing in our issue of December 1st, 1899, we are asked to state that Mr. J. F. Taylor has *not* been appointed general manager of the Madras electric tramways. He has been appointed assistant manager to Mr. Wm. Thom, who took over the duties of general manager of the Madras electric tramways on January 1st, 1900.

Electrical Engineers for the Front.—We understand that Mr. L. J. Lawrence, of Lawrence & Co., electrical engineers, of Stafford Street, W., having volunteered his services, has been appointed electrician to the City of London Imperial Volunteers and will sail on 20th inst. He will be assisted by Mr. Harry Woolhouse, who was formerly with the National Telephone Company.

The Royal Society.—Among the papers down for reading yesterday were:—Lord Rayleigh, F.R.S., "On the Viscosity of Argon as Affected by Temperature"; Hon. R. J. Strutt, "On the Behaviour of the Becquerel and Röntgen Rays in a Magnetic Field"; J. H. Grindley, "On an Experimental Investigation of the Thermo-Dynamical Properties of Superheated Steam by Prof. Osborne Reynolds' Method."

Glow Lamp Explosions.—A letter appeared in the *Times* of the 12th inst. from Mr. G. C. T. Bartley, M.P., in which an alleged "new danger" is described. It is stated that on turning on an electric lamp it exploded with a report like a pistol, the socket of the lamp was blown out, and the glass, in "myriads" of atoms, was sent in all directions; although a tilted shade saved his face, Mr. Bartley believes he got some of the powdered glass in his eye, for he was confined to his room, and unable to read at the time of writing. The lamps had been supplied by the Westminster Company shortly before Christmas, when the pressure was doubled; the company was unable to explain the cause of the accident. Mr. Bartley solemnly warns users of the electric light of the danger, and advises the use of some protection on lamps used near the face.

The explanation seems to us to be afforded by the expulsion of the lamp "socket," or rather the cap. This points most distinctly to a short circuit in the holder, which, at 200 volts, would act with explosive violence. Such a short circuit sometimes occurs when the cap is being inserted into a live holder—indeed, we have quite lately heard of more than one case where a lamp has "exploded" in the act of insertion into a holder without first switching off. A cap properly fitted into a bayonet holder is not easily knocked out, nor is it likely to be short-circuited; but if it is carelessly inserted it may be left in such a position as to provide the requisite conditions for a short, which would blow out the loosely-held cap, and by the shock fracture the bulb. The danger, therefore, lies in carelessness in putting the lamp in place, and neglecting to switch off before doing so. To suggest that the act of switching on a 200-volt lamp is likely to cause an explosion is absurd.

The Chinese Ambassador's Visit to Messrs. Glover's Works.—On Wednesday last His Excellency the Chinese Ambassador, Sir Chihchen Lofengluh, K.C.V.O., attended by his two sons and the members of his suite, including Messrs. Liu Wen Yu, Law Yuk Liu, Commander Chen Ugen Tao, T.C.N., also the Mayor of Salford, the Lord Mayor of Manchester, W. H. Holland, M.P., the Chief Constable of Salford, Messrs. Geo. W. Lowcock, G. Grindle, L. Cowen, and other important visitors, visited the Electrical Wire and Cable Works of Messrs. W. T. Glover & Co., Limited, at Salford. They were received by the chairman (Mr. Edmunds), and Messrs. Fawcus and Claremont, directors of the company, in their main offices, which had been transformed from the severe business aspect of a Manchester office to a room, the decorations of which consisting of mirrors, tapestry carpets and tropical plants, were an evident surprise to the visitors. At a large central table various examples of Messrs. Glover's manufactures were displayed, and Mr. Edmunds took the opportunity, in a few well-chosen words, of explaining to His Excellency not merely what they manufactured, but why the various kinds of material in connection with the insulation and construction of cables were used and applied. His Excellency evinced more than ordinary interest in what he heard and saw, and after going the round of the works, accompanied by the directors and staff, returned to the office, where in the meanwhile refreshments had been prepared. After his Excellency's health had been proposed, he replied that he was deeply interested in his visit, and he trusted that electricity would be a means of connecting more closely the friendly interests of China and Great Britain.

Municipal Critics and the Large Power Schemes.—In a one-sided criticism of the large electric power schemes now awaiting Parliamentary consideration, the *Municipal Journal and London* misses the essential point in these Bills, which is, that so far from seeking for a monopoly in the areas concerned, the promoters are simply asking for the right to supply in bulk the local authorities or others within the specified areas. They are not even asking for compulsory powers to supply in an area already controlled by a local authority, but only for the right to carry their mains through such areas in order to reach another one where their supply is wanted. Hence the writer of the article goes out of his way to write a great deal of nonsense when he speaks of "new dangers threatened."

The Coal Famine.—According to the *Westminster Gazette*, the scarcity of coal seems to be making itself felt over half Europe. In Austria, Germany, Italy, and probably elsewhere, the cry is for more coal. The Austrian naval authorities are loud in their complaints. The usually busy navigation of the Rhine is seriously disturbed; the price has risen alarmingly at all the Rhenish towns, and the Rhenish-Westphalian Coal Syndicate has announced a further rise. In Italy the dearth of coal is so extreme that several of the Lombard factories have been obliged to stop work, and in Milan, Genoa, Naples, and in Rome itself, appeals have been made to the Italian Government to take some measures towards securing a more adequate and regular supply. The *Capitale* expresses a suspicion that the "coal-lords" are hoarding their supplies in order to profit out of the coming disaster. Many Genoese factories are closed for want of coal.

Royal Institution.—The Friday evening discourse next week (January 26th), at 9 o'clock, will be delivered by the Hon. Charles A. Parsons, M.A., F.R.S., M.Inst.C.E. Subject: "Motive Power — High Speed Navigation — Steam Turbines."

London Chamber of Commerce and the Telephone Service.—Mr. Faithfull Begg, M.P., presided at a dinner of the London Chamber of Commerce at the Trocadero Restaurant on Wednesday evening. A debate on "The telephone system of the United Kingdom" was afterwards opened by Major General Webber, who was followed by Mr. Kimber, M.P., Mr. Provand, M.P., and others. Municipalisation, the treatment of the National Company by the Government, the Government scheme for London and other phases of the question were briefly discussed, but the consensus of opinion appeared to be practically in favour of the policy of unity of control which we have all along advocated in this journal. Some remarks by Mr. Kimber are worth special mention. He showed what a poor bargain Parliament made last year when it voted a couple of millions for the purpose of competing with the National Telephone Company, out of whose successful operations the country was drawing a 10 per cent. royalty profit. He also showed that had the Government, instead of providing for competition with the Telephone Company, bought out that company, at full value, with 10 per cent. compensation, it would now be earning a clear profit of 2½ per cent. on the £4,400,000 which it would have invested in the purchase.

What Gas Can Do.—It is recorded in the daily press that owing to an explosion in the Municipal Gasworks at Wiener Neustadt (Austria), that town, which is only an hour's distance from Vienna, and contains 25,000 inhabitants, will have to remain without gas for weeks. The theatre has already been closed.

Appointments Vacant.—An electrical engineer is wanted for the Glasgow Corporation tramways, at £300 to £400 per annum. See "Official Notices" for particulars.

An assistant electrical engineer is wanted for the Bedford station at £108 per year. See "Official Notices" this week.

NEW COMPANY REGISTERED.

British Compressed Air Tramways Company, Limited (64,722).—This company was registered on January 8th, with a capital of £75,000 in £1 shares, to adopt an agreement with the Electric and General Contract Corporation, Limited, to construct and equip tramways and railways, to work the same by means of compressed air, mechanical, electrical, steam, animal, hydraulic, or other power, and to carry on the business of telegraph and telephone proprietors, contractors for public and other works, &c. The first subscribers (each with one share) are:—A. D. Brown, 31, Reighton Road, Upper Clapton, N.E., writer; E. Wyatt, Bangor House, Lausanne Road, Hornsey, clerk; A. J. Swan, 20, Marsden Road, East Dulwich, S.E., gentleman; E. G. Church, 80, Leander Road, Brixton, S.W., clerk; R. A. Stebbing, 6, Penfield Street, Camberwell, clerk; T. E. Goss, 6, Great Woodstock Street, W., clerk; and P. E. Harris, 34, Walcot Square, S.E., storekeeper. Registered without articles of association.

SUPPLY STATION ACCOUNTS.

Hampstead Vestry Electricity Accounts.

THE accounts of the Hampstead Vestry electric lighting undertaking show that North-West London is appreciating the benefits of electricity supply, and that notwithstanding the residential character of most of the district, the field offered to the business is a remunerative one. The gross revenue and units sold have roughly increased by 50 per cent. Although the rate of increase is rather less than in one or two of the other London districts, it must be remembered that Hampstead has been at work for a rather longer time than they, and that the street lighting is still restricted to 53 lamps, whereas Islington, for example, had over four times this figure. One curious feature about the accounts is the absence of the engineer; the report is signed by the Vestry clerk, and apparently he has been entrusted with the preparation of accounts and report. Without questioning for one moment the ability of such an official, station engineers, at least, would attach rather more weight to the technical opinion of Mr. G. H. Cottam, the Vestry's electrical engineer. However, the Vestry clerk states "the income has grown from £15,930 to £24,377, about 53 per cent., while the expenditure has but increased by 45 per cent., a striking testimony to the care and economy of your engineer and staff at the station," a remark with which one must agree.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£100,177	£125,410	£25,233
Number of units sold	655,927	1,001,916	345,989
Total maximum supply demanded	613 KW.	917 KW.	304 KW.
Gross revenue	£15,372	£23,752	£8,380
Gross profit	£8,073	£13,001	£4,928
Average price per unit sold ...	5·43d.	5·49d.	·06d.

The revenue per unit works out at 5·68, which is almost exactly the same figure as was given in the Islington accounts last week. It has risen by just over the twentieth of a penny, but in the Vestry clerk's report he suggests the consideration of reduction in price, so probably the figure will fall in the future.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current (less discounts and bad debts)	£14,825	5·43d.	£22,919	5·49d.	+ 06d.
Meter rents ..	531	·19d.	802	·19d.	·00d.
Supply of lamps, &c.	...	...	...	...	...
Sundry	16	...	31	...	...
Gross revenue	£15,372	5·62d.	£23,752	5·68d.	+ 06d.

The costs of production for a London station are favourable; while "coal" and "repairs" (as might be anticipated) have gone up collectively by over ½d., the drop in management and establishment charges has brought the "total costs" down by nearly $\frac{1}{10}$d. "Wages" are low for a metropolitan works, but "repairs" are inflated owing to some heavy expenditure having been incurred in reseating the boilers during the year under review.

COSTS OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£3,330	1·22d.	£5,131	1·24d.	+ 02d.
Oil, waste, water and engine room stores.	403	·14d.	574	·14d.	·00d.
Salaries and wages incurred in generation and distribution.	998	·37d.	1,313	·31d.	− ·06d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	676	·25d.	1,889	·45d.	+ 20d.
Works' cost ...	£5,407	1·98d.	£8,907	·214d.	+ ·16d.
Rent, rates and taxes ..	363	·13d.	353	·08d.	− ·05d.
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	868	·32d.	991	·24d.	− 08d.
General establishment charges, stationery and printing, law charges and insurance	541	·20d.	480	·12d.	− ·08d.
Other expenses	120	·04d.	20	...	− ·04d.
Total costs ...	£7,299	2·67d.	£10,751	2·58d.	− ·09d.

The payments to interest and redemption have increased by about £500, but will be proportionately heavier in 1899. The Vestry clerk proposed that £7,500 of the net profit should be created into a reserve fund.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£2,980	£3,464
Sinking fund for repayments	1,188	1,197
Net profit carried to previous deficit	1,084	...
Net profit carried forward	2,821	8,340
Gross profit	£8,073	£13,001

CITY NOTES.

The Direct United States Cable Company, Limited.—The directors have resolved upon the payment of an interim dividend of 3s. per share, free of income-tax, being at the rate of 3 per cent. per annum for the quarter ending December 31st, 1899; such dividend to be payable on and after 31st inst., setting aside £15,000 to reserve fund account, and carrying forward a balance of about £6,347. The transfer books of this company will be closed from January 16th to 30th (both days inclusive).

Stock Exchange Notices.—The committee have appointed special settling days as under:—Wednesday, January 17th, British Westinghouse Electric and Manufacturing Company, Limited—100,000 6 per cent. preference shares of £5 each, £3 paid, No. 1 to 100,000; Tuesday, January 25th, Crompton & Co., Limited, further issue of 14,320 shares of £3 each, £2 paid, Nos. 32,099 to 46,418.

Globe Telegraph and Trust.—Quarterly interim dividends of 3s. per share on the preference shares and 1s. 9d. per share on the ordinary shares are announced.

Cape Electric Tramways, Limited.—An interim dividend of 4 per cent. has been declared. The dividend will be payable after the receipt of transfer returns from South Africa.

Electric Construction Company.—The transfer books of ordinary shareholders are closed from 18th to 31st inst. for the payment of the second half of the 6 per cent. dividend declared on July 13th last.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending January 15th, 1900, were £142 9s. 11d.; receipts for corresponding period, 1899, £118 15s. 6d.; aggregate for half-year to date, £288 7s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending January 13th, 1900, were £2,680 11s. 3d.; corresponding period, 1899, £2,556 11s. 5d.; increase, £123 19s. 10d.

The City and South London Railway Company.—The receipts for the week ending January 14th, 1900, were £1,124; ditto January 15th, 1899, £1,107; increase, £17. Total receipts for half-year, 1900, to date, £2,268; corresponding period, 1899, £2,250; increase £18. Miles open, 8½.

The Dover Corporation Tramways.—The receipts for the week ending January 18th, 1900, were £146 6s. 6d.; January 14th, 1899, £151 7s. 7d.; decrease, £5 1s. 1d. Total receipts to date, 1900, £305 5s. 7d.; corresponding period, 1899, £306 8s. 2d.; decrease, £1 2s. 7d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,954; 1899, 4,134. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, January 12th, 1900, were as follows:—D. U. T. Co., horse cars, £111 6s. 3d.; ditto, electric cars, £2,753 13s. 4d.; D. S. D. Co., electric cars, £578 18s. 5d.; total, £3 443 18s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,045 19s. 5d.; ditto, electric cars, £552 18s. 4d.; D. S. D. Co., electric cars, £600 8s. 1d.; total, £3,199 5s. 10d.; increase, £244 12s. 2d. Aggregate to date, £5,985 17s. 1d.; aggregate to date last year, £5,483 6s. 8d.; increase to date, £513 10s. 5d. The mileage worked is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending January 7th, 1900, were £557; January 11th, 1899, £238; increase, £319. Number of cars, 1900, 28; 1899, 10. Total receipts to date, January 7th, 1900, April 1st, 1899, £23,865; January 11th, 1899, from June 29th, 1898, £7,356. Week ending January 14th, 1900, £554; January 18th, 1899, £233; increase, £321. Total receipts to date, January 14th, 1900, from April 1st, 1899, £24,419; from June 29th, 1898, £7,589. Miles of track open, 1900, 12; 1899, 3½.

The Liverpool Overhead Railway Company.—The receipts for the week ending January 14th, 1900, amounted to £1,529; corresponding week last year, £1,337; increase, £192.

The South Staffordshire Tramways Company.—The receipts for the week ending January 12th, 1900, were £606 18s. 4d.; January 13th 1899, £228 18s. 8d. Aggregate receipts for 2 weeks, £1,012 2s. 7d.; last year, £1,086 16s. 2d.

STOCKS AND SHARES.

Wednesday Evening.

THE Transvaal War completely dominates the situation in every department of the Stock Exchange. By the reduction of the Bank rate to 5 per cent. last week fears of dearer money have been banished for the time being, and how little internal trouble the Stock Exchange has to cope with can be gauged from the fact that not a single failure took place last Friday, nor has there been one for over a week; so that the markets are able to turn their whole attention to political affairs and their own intrinsic values.

In the electrical departments the tone, on the whole, is good. Most activity is displayed in the telegraph section, but supply shares are also developing more strength, and traction issues have been bought to some extent within the last few days. National Telephone and some of the manufacturing companies' shares are improving, owing to the near advent of dividend announcements.

The electrical railway market keeps steady, with little alteration in prices. Discussion is rife as to what dividends are likely to be paid upon Waterloo and City Ordinary and City and South London Ordinary. The best opinion tends to a slight increase, in the case of the former, over last year's 3 per cent., while it is not expected that the City and South London will be able to do more than maintain its previous distribution of 2 per cent., even if it can do this, since fresh capital is now ranking for dividend without being so far productive. Central London shares were, of course, ex-dividend three weeks ago.

In considering what electrical supply shares would best repay an investor by a rise in price, we have several times instanced Westminsters, Metropolitans and St. James's. The shares of the last-named company are providing the feature in this market at the present time. Large buying orders have come in from people who, so gossips the market, have a very good idea of what the dividend is likely to be, and the price rose £1 on Tuesday, the Preference remaining unaltered. This rise in "Jimmies," however, merely takes the price back to what it was on the first business day of the year. Westminsters are better, and Metropolitan, old and new, are also up 10s. apiece. It is peculiarly interesting to note the distributions made by some of the supply companies a year ago. We turn the percentages into sterling for the sake of more ready comparison:—

Company.	Div. per share.	When paid.
	s. d.	
Charing Cross and Strand	5 0	February, 1899.
City of London Electric	7 0	February, 1899.
Metropolitan	5 0	March, 1899.
St. James's and Pall Mall	9 6	February, 1899.
Westminster	7 0	February, 1899.

Loud complaints are being raised in the City about the way in which the electric light service has lately been conducted. So bad has the light been on some occasions that gas and candles have had to be resorted to. We have already warned the City of London Electric Lighting Company that if it desires to retain the sympathy of its customers in its competition with the Charing Cross Company, it must look to its lamps. The Stock Exchange, it may be observed, makes its own electricity, and is independent of any outside aid.

The telegraph market is chiefly remarkable from the lively speculation that has arisen over Anglo-American Deferred (the familiar "A") stock. Dividend forecast ranged from 25s. to 30s. per cent., against the 18s. per cent. paid a year back. A distribution of 1¼ per cent. will yield over 7 per cent. on the money, but the "B" stock is a more attractive investment, paying 5 per cent. on the money even now. Direct United States shares improved on the declaration of a dividend of 3s. per share, but Globe Telegraphs did not alter when the notice was posted in the market that 1s. 9d. would be paid on the Ordinary. Eastern Ordinary has again advanced, and notwithstanding that the price is now *ex* dividend, it is quoted above that which ruled a week ago. "Chinas" are unchanged, but Brazil Submarines are better, our view that they are a cheap investment finding investors of the same opinion.

Buyers have come forward for British Electric Traction issues, more especially the Preference, and a large number of shares now change hands daily. The Parliamentary Bills give great hope for important developments in the direction of light railways, and it is urged that the British Electric Traction Company will be sure to profit largely by the extension of the system. Tramway shares exhibit no quotable alteration.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Jan. 10th.	Closing Quotation, Jan. 17th.	Business done during week ended Jan. 17th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	64 — 67	64 — 67	66½	...
3,062,240	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	113 —115	114½—115½	115½	114¼
3,062,240	Do. do. Deferred...	Stock	...	...	18s. %	17 — 17½	17½— 17⅝	17⅝	17⅛
205,993	Brazilian Submarine Telegraph	10	7 %	7 %	...	14½— 14⅝	14⅝— 15	14⅝	14½
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	106 —109	106 —109	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,332,833£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	104½	102½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	8½— 9½	8½— 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	101—105%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11½ — 12	11⅜— 12¼	12⅛	11⅞
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	99½	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	148 —153	151 —156 xd	155	150½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	96 — 99	96 — 99 xd	98½	96⅜
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	114 —119	116	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 15	14¾— 15½xd	15	14 15/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
820,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
17,400	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red., Reg. Nos. 1 to 2,343	100	5 %	...	...	... ...	... ...	...	...
24,500	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	... ...	... ...	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	101 —104%	101—104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	10⅜— 11¼	10⅜— 11¼	11¼	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14¾— 15½	14¾— 15½	15½	14⅞
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	32	30¾
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	101	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	...	⅛— ⅜	⅛— ⅜	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5 — 5¼	5⅜ — 5⅝	5½	5¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅞	14¾
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14¾	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5¼	5⅜	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	98 —100	98 —100	99	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	101 —104	101 —104	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	125	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4½ — 5	4¾ — 5⅛	4⅞	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	... ...	4¾ — 5⅛	...	...
179,947	Do. do. 5 % Debs.	Stock	...	..	...	102 —105	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	102 —105	1 0 —104	...	...
88,823	West India and Panama Telegraph	10	1 %	3%	...	⅞— 1⅛	⅞— 1⅛	1	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	9¼— 9½	9¼— 9⅝	9⅝	9¼
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	6	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	109 —111	109 —111	110½	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	10 — 11	10 — 11	10¾	10¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	9½— 10½	10	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	107 — 110	106 —109	109½	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	4¾— 5½	4¾— 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	2½— 2⅝	2½— 2⅝	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	5½— 6	5½— 5⅞	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	102 —104	102 —104	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	13½— 14½	14 — 15	...	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13 — 14	13½— 14½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	116 —118	115 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	... ...	95 — 97	95½	95¼
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	14 — 15	15 — 16	15⅝	15 1/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	13½— 14½	14 — 15	14 5/16	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Jan. 10th.	Closing Quotation Jan. 17th.	Business done during week ended Jan. 17th, 1900. Highest.	Lowest.
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	10 %	...	2⅜ — 3½	2⅜ — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	15 — 16	15½ — 16½	16½	15½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	12⅜ — 13½	13 — 13½	13⅜	13⅛
200,000	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	125 —128	125 —128	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½ — 12½	11½ — 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500	5	...	...	...	6½ — 6⅝	6 — 6½ xd	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅜ — 2	1⅜ — 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	2 5/16	2⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	110 —115	110 —115	114½	113½
50,000	Do. do. 4½ % 2nd Deb. Stock Red.	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	10 %	12½ %	15 %	12½ — 13½	13 — 14	13⅝	13⅜
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —115	110 —115	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9½ — 10	9½ — 10	10	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4½ — 5	4½ — 5	4 11/16	...
71,447	Do. do. Def. do.	5	...	...	...	4½ — 5	4½ — 5	4 11/16	...
855,000	City and South London Railway	Stock	1 2/16 %	1 11/16 %	2½ %	59 — 62	59 — 62	60	59
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd.	10	...	...	...	4½ — 5⅛	4½ — 5⅛	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3⅝ — 4	3⅝ — 4 xd	3⅞	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 —101	93 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	1⅜ — 2½	1⅜ — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red.	100	...	...	...	93 — 95	91 — 93	91⅝	91¼
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	1⅞ — 2½	1⅞ — 2½	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000	2	7 %	7 %	7 %	2⅜ — 3½	2⅜ — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock	Stock	...	...	...	104 —107	103 —106 xd	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12 — 13	12 — 13	12⅜	12 7/16
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5 — 5⅛	5⅛ — 5⅜	5⅜	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works	10	10 %	10 %	10 %	20½ — 21½	20½ — 21½	21¼	20¾
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	101	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅜ — 8⅞	8 13/16 — 8 15/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13¼	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	35 — 39	37	36½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909	100	...	...	...	102 —105	102 —105	104	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	...	...	9 — 10	9 — 10	...	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 102—105.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, ⅛—1⅛.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7—7½. Debentures, 102—105. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (January 11th, 1900).

MARKET QUOTATIONS, Wednesday, January 17th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal)	per ton	£29	£29	..
a " "	per ton	£27	£27	..
a Bleaching powder	per ton	£6 1	£6 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£24 10	£25 10	£1 dec.
a Lead, Nitrate	per ton	£25	£25	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
Methylated Spirit	per gal.	2/9	2/9	..
Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	5d.	5d.	..
a " Caustic (75/80 %)	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a " Bichromate, casks	per lb.	4½d.	4½d.	..
METALS, &c.				
Aluminium Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£75 to £135	£75 to £135	..
c Brass (rolled metal 9" to 12") basis	per lb.	8d.	8d.	..
c " Tube (brazed)	per lb.	10d.	10d.	..
c " Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	3/-	3/-	..
f " Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£82	£82	..
g " Wire (basis price)	per lb.	10½d.	10½d.	..
g " Sheet	per ton	£82	£82	..
g " Rod	per ton	£82	£82	..
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine	per lb.	4/7 to 4/8	4/6½ to 4/7½	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	68/1	66/4	1/9 inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i " Wire galvanised No. 8	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 5	£16 12 6	7/6 dec.
g " " Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet	per lb.	From 1/2¼	From 1/2½	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£120 10 to £121 10 nom.	£116 to £117 nom.	£4 inc.
g " foil	per lb.	1/9	1/7	2d. inc.
n " wire Nos. 1 to 16	per lb.	1/10	1/8	2d. inc.
p White Anti-friction Metals— "White Ant" brand	per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
f " Best Flax, 6 lea.	per lb.	5½d.	5½d.	½d. inc.
j " Hemp, 8 ply 10 lbs.	per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs.	per lb.	4½d.	4½d.	..
f " Jute, 180 lbs. rove	per ton	£14 5	£14	5s. inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£24 5 nett.	£24 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

GASOLINE GAS FOR BOILER HEATING.

AT a meeting of the American Society of Mechanical Engineers at New York in December, Mr. Herman Poole gave a paper on "Experiments on Using Gasoline Gas for Boiler Heating."

The principal object of the experiments was to determine whether gas made with gasoline could be used to raise steam in boilers, and at what cost.

Before going further into the question, as gasoline is not so commonly known in England as in those countries in which petroleum is found in its crude state and prepared for commerce, it may be explained that "gasoline," or, as it is generally called in England "gasolene," is one of the products derived from the preparation of crude petroleum for commercial purposes. Crude petroleum is subjected to distillation, and there are given off, at temperatures below and approaching 150° C. (302° F.), vapours which, when condensed, are found to consist of rhigolene, gasolene, naphtha, benzine, ligroine, &c., amounting in all to from about 4 to 16 per cent. of the crude material.

From this it will be apparent that gasolene will be cheaper, and more readily available, in those countries where the crude petroleum is purified for commerce. The cost per gallon is given at 10 cents, which, on the English gallon, would be 13·5 cents, or, say, 6d; that is to say, in those countries where gasolene is sold at 10 cents or 5d. the gallon (American), the English gallon would cost 6d., but this is not equivalent to saying that gasolene could be obtained in England for 6d. per gallon, as it is retailed in comparatively small quantities, and then carriage would have to be added. Gasolene is very inflammable, the flash point being 32° F., while paraffin oil has a flashing point allowed by Government as low as 73° F.

The experiments described by Mr. Herman Poole were carried out in a very crude way, but are described in a very detailed manner.

If the results of the experiments had been more accurately determined, and analyses and other particulars taken, they would have been of some considerable value; but as only certain particulars were obtained, it is sufficient to say that the thermal value of the gasolene was 20,000 B.Th.U., and under the circumstances, it was proved that gasolene could be employed to raise steam, as shown by the following heat balance table:—

HEAT BALANCE.

Total heat value of 1 lb. of oil, 20,000 B.Th.U.

	B.Th.U.	Per cent.
Heat absorbed by boiler	3,483,250	76·5
Loss due to water formed by combustion of the hydrogen	385,100	8·5
Estimated loss due to heat in chimney gases	236,600	5·0
Loss due to absorption, radiation, &c. ...	445,050	10·0
	4,550,000	100·0

In the experiment it was estimated that 35 American gallons of gasolene were used, weighing 227·5 lbs., to evaporate 1,000 lbs. of water, at a cost for oil of 14s. 7d. for 100 English gallons of water turned to steam at 60 lbs. pressure.

This, in the ordinary steam practice, at 20 lbs. of water per I.H.P.-hour, would be equivalent to 3½d. per I.H.P. for fuel, in place of ·1d. when using coal at 15s. per ton, which goes to show that gasolene would only be available as a steam raiser for special purposes.

STANDARDISING IN ENGINEERING CONSTRUCTION.

IN Sir Benjamin Browne's final paper on this question in the *Engineering Magazine* he has, we think, fallen somewhat into error. We quite agree with him that it is folly to suppose that a combination of employers to raise prices all round would enable them to pay better wages, and that the public would in the end have to pay. Of course, this is just what the public does not do. High prices tend to check the public and their expenditure, and put a curb on any too serious attempt to raise prices. But Sir Benjamin himself appears to us to make a very serious error. He appears to be much of a Smiles in his ideas, for he evidently thinks of nothing but saving money to invest it, whereby, he says, the saving men find employment for engineers and others.

Arguing on this basis, he says it is better for the capitalist to get hold of a certain £100,000 that may be on the loose, than that it should go into the pockets of many workers. Sir Benjamin, in fact, looks so one-sidedly at the idea of investing money to pay 5 per cent., that he entirely overlooks the consumer. Carrying his argument out, we should all do our best to spend nothing at all, but save it for investment. Sir Benjamin ought to know that as soon as the great public begin to lose faith in the continuity of good times, they do begin to hoard. A housewife makes her old kettle last a bit longer, and the shabby curtains are hung once more, and the repetition of these paltry and apparently insignificant acts throughout the breadth of Europe in millions of homes soon throws a Wolverhampton on bad times, and stops a few Nottingham looms, and puts another check on consumption, and so the ball of distrust feeds on its own effects and bad times are said to have arrived, which simply means that people are only buying necessaries; and the bad times continue, and people live when possible within their means for so long, that many of them hoard money, and in due time they begin to spend it and trade revives. But trade ought never to have become slack; if people had not been too extragavant it would have gone steadily on, and it is because the great public of weekly wage earners are not thrifty and investing that consumption goes on. Yet Sir Benjamin would stop the consumer and altogether magnify production. Such, at least, is the logical trend of his arguments. Unfortunately for the capitalist class the workmen have no trust in his ways, and prefer to spend their money rather than entrust it to the wily capitalist. We see no reason why the workman should not obtain a full share of the profits of trade, and it should not be forgotten that without trades unions he would have been tyrannised over quite as much as he has tyrannised over the employers.

But Sir Benjamin, in denouncing Socialism, commits the common error of thinking that Socialism implies simply the dividing up of all goods in equal shares all round. The great question to our mind for the working man to consider is, how is he going to treat his employer? In the first place, if the workman would be more self-respecting and would join with his fellows in making firm demands for just rights, he would effect much, but at the same time he must show a clean sheet on his side, and must cease the shirking policy under which he has been compelled to defraud his employer of late years. Trades unionism has had a heavy blow, but it has arisen from men who have crept into its ranks from the class who have imposed on their fellows by being too glib of tongue. Why is it that certain trades unions appear to get along all right without strikes, and yet to maintain their members in good wage-earning employment? The answer is, that their officials have made this their aim, and have not made of their offices merely a stepping stone to Parliament. Employers, as a rule, cannot afford to reject a fair demand, and no well-conducted union need ever resort to a strike. We are of opinion that an eight hours' day would long since have been secured by workers determined to have it, and sensible enough to ask at the same time for a one break day, and to make sufficient clamour for trains to carry them. As matters are, the eight hours' day is not practicable; first, because the men would have to sacrifice the half price of the workmen's trains; secondly, because already the existing railway companies cannot carry those who travel between the hours of 7.30 and 9.30; and thirdly, because the greatest enemies to the comfort of the working classes themselves are the London County Council and other municipalities who have done their best to nullify the wishes of Parliament by using every artifice of which they were capable to stamp out the demand for better means of transport. Whatever the working man has suffered has been quite as much through his professed friends as from his supposed enemies.

It is a standing disgrace to the working man of to-day that his home and surroundings are so miserable, for the average income of the working class man is far greater than that of the poorer of professional people. The expenditure of the workman, as a class, on beer is simply disgraceful. But the respectable body of the working class form the great consuming class of the community, and are quite overlooked by Sir Benjamin, whose idea of the public seems to be as of some entirely separate set of people on another planet, whom we must placate by cheap prices and unlimited production, to which end we must all save, and invest, and reduce our consumption to a minimum, which is irrational. The Socialism of the real thinking man is simply that all who will work need never fear to starve, and therefore thrift becomes folly. But we know of no such Socialist who thinks his doctrines could be safely applied, for nine-tenths of mankind would cease to labour honestly unless a superior force, and a merciless, put them beyond the pale to perish. Without absolute honesty, successful Socialism would either be impossible or would be compelled to put half the people to death. Strange that, for lack of so simple a matter as common honesty, the whole world is shut out of paradise!

LARGE ELECTRIC LIGHT ENGINES.

IN discussing the question of large engines for electric light purposes, Mr. R. D. Summerfield comes very near to attempted prophecy in the pages of our contemporary, the *Electrical Engineer*. To begin with, he goes boldly into the discussion of single and double-acting engines, and is a champion of the former variety up to 200 H.P. at 400 to 500 revolutions per minute. He commits the common mistake of all single-acting advocates when he says that the crank pin of a single-acting engine always has the pressure in one direction. The constant thrust affects only the piston and connecting rods, and the permanence of the widespread error as to the crank pin is a curious feature in the advocacy of single-acting types. So, too, is the claim that such engines are self-draining. They are not more so than other engines. It is also held by some engineers to be a very serious fault of single-acting engines that they are so difficult to lubricate, and that only certain oils are available for lubricating them, the price of which is excessive as compared with the general run of lubricating oils.

The author claims that for large engines those of double-acting type are preferable, being so very much smaller for equal power and capable of perfect lubrication by forced oil lubrication. The high speed double-acting multi-cylinder engine, of which he approves, has he fears, a rival in the two-cylinder low speed type of compound engine, which is being put down in large numbers—chiefly, we should imagine, where American influences are at work, and not from any particular merit of the class, which is unnecessarily clumsy, and is run at about half the speed that engines of equal size are run when under English influence.

The type of engine he advocates would have eight cylinders and four cranks at 90°, the shaft supported in swivel bearings mounted on screwed pillars capable of being raised or lowered for adjustment,

or removal of lower brasses. He would support the cylinders on cast-iron or steel columns, with filling plates of sheet-iron fitting oil tight, but quickly removable. Connecting rods he would make hollow, and utilise as oil reservoirs for the big ends. As 200 revolutions is a low speed for a governor, he would drive this by gearing at 400 revolutions. Simple heavy discs of small diameter are, he says, all that are necessary as fly-wheels with the number of cranks proposed. It seems to us that the advocacy of engines with so many cranks is a confession of weakness. The author urges that if one cylinder of a two-crank engine should break down, the remaining half of the engine would be unable to do the work, but the breakage of one of three cylinders would still leave two-thirds of the power available. Rather than the cylinders, we must assume that it will always be the crank or the shaft that is going to give way.

This constant attempted provision for shaft or cylinder breakage in an electric light engine is an unhealthy legacy from the ill-considered attempts of electrical engine builders to make a 2-inch shaft perform the duty proper to a 4-inch shaft, so that finally it has become a sort of gospel that cylinders and crankshafts must inevitably come to grief—a doctrine utterly pernicious, and founded on too keen a desire on the part of engine makers to shelter bad design and practical ineptitude behind a supposed doctrine of total depravity of shafts—a blessed doctrine indeed for engine builders, so long as steam users could be induced to live up to it. Cylinders should rarely give way, and crankshafts have only done so from sheer weakness that ought not to have been permitted.

Forced lubrication is a practical necessity that should be provided in high-speed engines. This, with ample bearing area, must effectually prevent seizing of the bearings where due provision is made for the penetration of an oil of suitable viscosity.

Our author is a little out of his reckoning in relying on the number of cranks of a four-crank engine at 90° to reduce the necessity for a heavy fly-wheel. The arrangement, after all, only has the same turning moment as a two-crank engine with cranks at 90°.

It is stated that a 2,500-H.P. steam turbine is to be built in America or elsewhere, and if it proves a success a very different state of things in the near future may be looked for. The steam turbine has, so far, not received the recognition of engineers to the extent that we think is due.

ELECTRIC DRIVING IN DYEING AND CALICO PRINTING WORKS.

It has been held for a long time past that one of the most profitable fields for the introduction of the electrical distribution of power is in works devoted to calico printing and finishing. It is absolutely essential, however, that a calico printing machine should be under the ready and absolute control of the operator. Moreover, it is highly important that there should be easy regulation of speed. The old method of driving printing machines through the medium of line shafting and clutch gear giving different speeds has been long abandoned, and the most common practice, apart from electrical motors, is to employ an independent engine geared on to the shaft of the machine. It is obvious that such engines cannot, under any circumstances, be economical, because the engines have to be frequently started and stopped, and at low speeds they must of necessity have extremely low efficiency. It is hardly necessary to speak of the continuous losses that arise in the necessarily long lengths of steam pipes where separate engines are employed. But though, at the first glance, it might appear that electric motors could be instantly adopted for such purposes, there are, however, certain initial difficulties to overcome. One of the most serious problems in the driving of calico machinery is the providing for the numerous variations in speed, and in some cases, particularly in Lancashire, this has been solved by means of a specially devised switch, which has something in common with the series parallel controller. In one well-known case, by an arrangement of the three-wire system, it is possible to supply the motors with variations of 100 volts and 200 volts, and this means gives such a degree of nicety in controlling the speed that it has been found possible to vary the speed of the calico from 5 yards to 60 per min., with, of course, many intermediate stages. An interesting example in the adoption of electric driving for such machinery is to be found in the works of the Berlin Bleaching, Dyeing and Printing Company, at Oberspree. In these works, some 17 motors, varying in size from 40 down to 5 H.P., drive bleaching and drying machinery, calenders, foulards, jiggers, and printing machinery. In this instance the supply of current is obtained from the Oberspree public electric lighting station, the price charged per unit being as low as 1½d. 6,000-volt three-phase current is supplied to the transformers in the dyeing works through triple concentric underground cable, and is reduced in the case of large motors to 500 volts, and for motors under 15 H.P. to 110 volts. From the low tension side of the transformers the conductors are taken to a main switchboard and the distribution of current is effected through two separate boards, one of 500 volts, and the other of 110 volts. Obviously, as the machinery driven varies considerably in size, the driving from the motor is done on different methods. In some cases the motors are direct coupled to the machinery, in other cases shafting is employed, in some instances double-tooth gearing is used; and in a few cases triple-tooth gearing. There are other cases where a machine is driven through the medium of belting. Where machines are taking a somewhat small power and working with a fair degree of regularity, power is transmitted to the motor by means of belts and shafting; and it may be interesting to many to learn that in such cases the motor is started by means of a liquid resistance. The principal machines, however, such as a hydraulic mangle, and the calenders, are driven by separate motors. The motor for the hydraulic mangle is direct coupled to the main shaft and turns the rollers, as well as working the pump and feeding the hydraulic arrangement for bringing the rollers together. The limits of speed necessary in the printing machine vary from 5½ to 48 yards per minute, and a metal resistance is employed, the contact lever being operated by an under wheel. The following table shows the various details of the machinery driven at the Oberspree factory:—

Revs. of motor per min.	H.P.	Starting appliances.	Connection to machines	Department.	Machinery driven.
73·5	40	liquid resistance	shafting	bleaching	3 washing, 2 acidifying, 1 chloring machine, 1 boiling apparatus, 1 stroth stretching frame and sundry appliances.
1,425	6	metal resistance with speed regulator	shafting	bleaching room	1 drying and stretching machine.
950	10	liquid resistance	shafting	preparatory	3 raising and 1 cropping machine and 1 ventilator.
475	20	liquid resistance	coupled direct	finishing	1 hydraulic mangle.
950	15	metal resistance with speed regulator	double-toothed gearing	finishing	1 calender.
1,425	8	ditto	ditto	ditto	1 calender.
950	15	ditto	ditto	ditto	1 calender.
1,425	8	liquid resistance	belting	ditto	2 starching machines, 1 dresser, and 1 pump.
950	15	ditto	ditto	ditto	1 stretching, 1 winding, 1 folding, and 1 sprinkling machine, and sundry appliances
1,425	5	ditto	double-toothed gearing	dyeing	1 drying machine.
1,425	5	ditto	ditto	ditto	1 water calender.
1,425	8	ditto	belting	ditto	4 foulards, 6 jiggers, and 1 ventilator.
950	20	metal resistance with speed regulator	triple-toothed gearing	printing	1 duplex four-roller printing machine.
950	15	ditto	belting	ditto	1 four-colour printing machine.
1,425	8	ditto	ditto	ditto	1 two-colour printing machine.
950	15	ditto	ditto	ditto	1 six-colour printing machine.
950	15	ditto	ditto	ditto	1 eight-colour printing machine.

POWER LOSSES IN THE MACHINE SHOP.

MR. C. H. BENJAMIN, in the *Engineering Magazine*, thus distributes the horse-power expended in the ordinary machine shop:—

Engine friction	10 per cent.
Line shafting	15 „
Belts and pulleys	15 „
Empty machines	15 „
Cutting metal	45 „
Total	100 per cent.

and even this efficiency is probably only realised when everything is working at full capacity. Of all metals cut in the machine shop, cast-iron is said to absorb least power per unit of weight removed, while the harder sheets require the maximum. Thus, to remove 1 lb. of cast-iron per hour requires the continuous expenditure of from ·015 to ·030 H.P., or, say, an average of one-fortieth of a horse-power, where steel calls for one-twenty-fifth of a horse-power. An average lathe will cut 10 to 20 lbs. of cast-iron per hour and absorb ¼ to ½ H.P. in useful work, and similarly steel will be removed at a rate of 5 to 10 lbs. and demand one-fifth to two-fifths of a horse-power. Much also depends on the condition of the machine itself, which may increase its demand for power from 0·36 to 2·3 H.P. very quickly, simply from a dry main spindle. A lathe run without cut may absorb 0·04 to 0·16 H.P., and this will mount up to 0·3 or 0·4 simply by tightening the work in the centres. A large 84-inch wheel lathe has been found to absorb 1·75 H.P., and when cutting 5·8 H.P. on heavy work.

Planers use ·035 H.P. per pound of cast-iron removed per hour, and 0·065 H.P. per pound of steel, and they may remove 20 lbs. of soft steel or 30 lbs. of cast-iron per hour. Ordinarily, however, a machine would not consume 1 to 1·3 H.P., as these figures would indicate, but only about ¼ H.P. Adding for friction the machine will probably require an average power of 1·0 H.P. in ordinary work.

The author cites numerous tests made to determine power absorption by various machines, and generally finds that over half the power is lost before it gets to the machine in ordinary methods, but even with electrical driving there is some considerable loss in transmission.

We have, personally, no doubt that the more direct the application of electric motors the better will be the economy in many instances, but we believe sub-division may easily be carried too far where many small machines are placed near together and driven more or less intermittently. In such a case one small line shaft and one motor will drive all the little machines, and the motor will be of far less cost and power than the aggregate of motors if applied one to each machine. But for large machines, single motors to each machine are a decided economy, and we have had brought to our notice the case of a building occupied by several printing firms, one of which has motors to each machine, and uses only a fraction of the current used by other firms of no greater capacity, but employing fewer motors and a considerable length of shafting. Apart, however, from the mere item of power consumed, electric driving has the advantage of allowing:—

1. A better arrangement of machinery to facilitate handling of work.
2. Clear head room for the use of lifts and cranes.
3. Light and cleanliness.
4. Better flexibility for changes and extensions.

On the general question of economy, it is in the power that is not used that saving is effected. We once referred in these columns to a little shop where the use of electricity would save about £300 per annum. Since writing that, the proprietor, who hesitated to spend £50, has spent considerably more in putting in a new boiler, and he is still taxing himself for the coal and wages, out of all proportion to the very short hours during which he would use current. It is the small shop proprietor who can effect the biggest economy in the power he pays for.

AN AMERICAN PACIFIC CABLE.*

By GEORGE OWEN SQUIER.

(*Continued from page 75.*)

Proposed Management of the Cable as a Government Enterprise.

Assuming that the proposed Pacific cable will be established by the Government, opportunity will be presented in this new and unoccupied field of the Pacific, unfettered by precedent and obligations, to introduce such radical changes in the policy and business management of the enterprise as will operate advantageously to the whole people who are directly concerned, and for whom the cable is primarily built. Private corporate management naturally aims at large dividends for its stockholders. It is a matter of statistics that in cabling throughout the long distances involved in the East, out of every 100 messages sent, 99 are purely commercial in character, and one of private nature. Cabling throughout the world is so expensive, that it is only resorted to for urgent commercial purposes. The present tariff rates strictly limit the kind of traffic offered, and prohibit all other than that of the most urgent nature, and are sufficiently high to keep the long cables actually idle for a considerable portion of each 24 hours. The enormous volume of the present mails indicate that the world's cable plant could be duplicated many times, and all kept full to overflowing, if the cable rates were sufficiently reduced.

Electricity the Ideal Medium for Transmitting Intelligence.

The triumphs of science in the last half century have been nowhere more exemplified than in the enormous strides made in the facility of transmitting intelligence. The mails, the telegraph and the telephone are civilising the world. Perfect as is the mail system of to-day, a monument to organisation, yet, its swiftest messenger—steam—is so far outstripped either on land or sea by the practically instantaneous electric current, that the tendency year by year is to put more of the world's business "upon the wire." The time is fast approaching, let us hope, when a telegraph and cable letter service at rates comparable with present postage rates will be realised throughout the world, with its consequent revolutions in business and social methods. Time has an international money value. The fastest mail express, or the swiftest ocean mail ship, are as naught compared with the velocity of the electrical impulse, which practically annihilates any terrestrial dimension. As the distance increases, electricity surpasses steam in a continuously increasing ratio. In the case of a message to be sent across the street, probably there is no more efficient and satisfactory method than by a mail delivery messenger; but if this message is to be sent half-way round the earth, the minutes required by the telegraph, run into weeks and months by the slow process of the mails. Steam time is directly a function of the distance to be traversed, and from the nature of things must require twice as long to go two miles as one. If then, the cable saves six days between Europe and America, it will save more than twice this time between America and the East, and is, from this point of view, correspondingly important and necessary. Since electricity so far outstrips any other known vehicle for transmitting intelligence, it must eventually carry all the important information and practically take from the present mails more and more of the most urgent letters.

Continuous Use of the Cable Proposed.

With the Pacific cable in operation, and possessing such immeasurable advantages over the mail, how can any management be entertained which does not aim at the use of the cable continuously to its fullest capacity? Cable property is peculiar in that it does not, like mechanical machinery possessing moving parts deteriorate with use, and its life is not therefore dependent upon the amount of traffic transmitted. The ordinary manufacturing plant is usually not operated continuously because the coal consumption, the wear and tear of machinery, and the extra expense of employés—combined with the state of orders received, do not present a sufficiently attractive economical proposition. But a large cable property presents unique conditions from a purely business standpoint. The bulk of the capital invested is buried under the sea, and much the largest item to be earned is the interest on the capital. A 2,000-mile line requires but two operating stations, and the annual expense of a few clerks who actually operate the plant, forms a comparatively insignificant part of the total annual expense.

In the estimate of Mr. Alexander Siemens upon the British Pacific cable in a paper at Ottawa in 1894, but 12 per cent. of the total annual expense was for operating staff proper, and this also provided for more than double the usual wages, in consideration of the isolated positions of the mid-ocean stations. Add to this the fact that what ordinarily corresponds to coal consumption, here consists of a few electric batteries, and is therefore practically *nil*, and also the fact that using the plant causes no deterioration, and the logical business conclusion is reached that ocean cables should be kept busy continuously. Every hour they remain idle is so much service absolutely lost. Present cable tariffs are so high as to force to idleness for a considerable portion of each 24 hours all of the long cables of the world. In addition the Atlantic cables are practically silent one day in seven.

In defence of the present management, too often unjustly criticised, it is submitted that cable property on the whole has been particularly hazardous and uncertain; repairs often most expensive, and a prudent management has required large sinking funds and reserves. Furthermore, the necessary traffic arrangements required with co-operating or competing companies establish precedents and form obligations not easy to suddenly change. The whole of cable history does not yet cover 50 years, but the skill and experience of the large cable manufacturers in England have brought this industry to such a state of perfection that the laying of a 2,000-mile ocean cable, or its repair, in 3,000 fathoms, is no longer considered a particularly hazardous undertaking. In fact, in the beginning, cable rates had to be high, and although there has been a steady decrease in rates to the present, as the technical side of the business has become more stable and certain, yet it is believed that the time has now arrived when a more extensive classification and reduction can be inaugurated with advantage both to patrons and to revenues earned.

As a practical means for operating the cable continuously, it is a natural suggestion to classify the traffic offered and establish differential rates therefor as is now universally done on landlines. The same causes which have established night rates on land are much more potent in case of ocean telegraphy where the time gained and the capital invested per mile is enormously greater. It is simply a matter of paying for time. The Stock Exchange message where minutes are valuable should be charged the highest rate, while the press and less urgent business messages should be classified and paid for according to the time limit called for in delivery. Since the only other competitor in the Pacific is the mail steamships, where the minimum time is over two weeks, it should be easy both to create new business, and to draw from the mails as desired. In handling certain classes of messages, it can be distinctly agreed to deliver only within a certain number of hours or a week, or even establish a low Sunday rate for certain classes of matter, and still arrive much ahead of letters sent by mail. If we have no less than four classes of matter in the present mail system by steam train, why not a classified service for an ocean cable postal system where the reasons for it are more potent?

For the fiscal year ending June 30th, 1898, the amount of mail matter, letters proper, excluding all other forms of mailable material, carried in mail steamers from the United States across the Pacific Ocean for Japan, Hong Kong, Shanghai, Manila, Singapore, Cochin China, Java, and Siam was about 10,948,651 grams, representing about 1,156,176 letters. From the United States for Hawaii, 3,495,442 grams, representing about 369,072 letters. This reveals the appreciable proportion of the Pacific traffic which stops at the Hawaiian Islands, being from the above figures about 25 per cent. of the entire traffic which in 1898 left the United States for these countries. These figures are instructive as indicating that in considering the through trans-Pacific cable, the Hawaiian traffic is not entirely to be ignored, and that of the entire length of the cable, the span between California and Hawaii will continuously be required to carry a materially greater portion, and will, therefore, be the first span requiring duplication.

Assuming, as above, that the carrying capacity of the proposed cable be equal to that of the best Atlantic cables for corresponding lengths, it is of interest to obtain in a general way the amount of traffic which can be handled across the Pacific under a management which ensures the cable being used continuously.

The proposed cable should possess a carrying capacity each way per annum of about 5,900,000 code words of eight letters, and this allows 30 per cent. of the entire amount as waste or non-paying traffic. This means, of the 1,156,176 letters which in 1898 were transmitted to

* A paper presented at the 138th meeting of the American Institute of Electrical Engineers, New York and Chicago, December 27th, 1899.

Japan, Hong Kong, Shanghai, Manila, Singapore, Cochin China, Java, and Siam, this entire number could have been transmitted by cable, allowing for each communication about five words of eight letters each. Since the use of code books for cable messages has so much increased that practically all cabling is now transmitted in this manner, we can reasonably take one word equivalent to five by their use, so that each communication above referred to is equivalent to 25 words of average length.

MEANS FOR DUPLICATION.

All important submarine cables should be duplicated as soon as possible. Cables are always liable to interruption from a variety of causes, and the interruption of a single line necessarily suspends all communication. The protection of the patronage requires duplicate lines if for no other reason.

An adequate plan for a Pacific cable should consider means for the duplication of the line. In this connection an examination of the Pacific ocean, and the route of the proposed British Pacific cable from Vancouver to Australia, suggests a span of cable of international value. Reference is made to the desirability of connecting Hawaii and Fanning Island with an Anglo-American cable, operated by the governments concerned, under rules mutually acceptable. A common interest should lead to the linking together of these two great ocean telegraphic routes in the mid-Pacific.

With this single span of cable laid, which is but about 950 nautical miles in length, or but 13 per cent. of the length of either of the main lines, it results that each country has practically ensured its line against a total interruption until such duplicate lines can be laid as the growth of the business will undoubtedly warrant.

Thus in case the British cable between Canada and the mid-Pacific should be interrupted, it would only be necessary to route the British business for Australia, arriving at Vancouver - over the United States landlines to California to be transmitted over the United States cable to Hawaii, thence over the international span to Fanning Island, and on to Australia *vid* the British line; or in case the American span to Hawaii is interrupted, the United States can likewise reach these islands and the East by routing traffic to Vancouver for transmission to Fanning Island, and thence to our trans-Hawaiian cable also *vid* the international cable span.

In a similar way, in case any section of either through cable is interrupted beyond the Hawaii-Fanning span, the urgent United States traffic can be routed from Hawaii westward *vid* Australia and thence to the East, or the urgent British business can reach Australia *vid* Manila.

It is believed that such a living and equitable arrangement can be effected in the working of these Pacific cable systems as would afford security to each and result in mutual traffic advantages to both enterprises. Thus there is no reason why the present Atlantic cable system and the United States land systems should not eventually serve as material feeders to and from Australasia, and likewise the British and Canadian systems supply an appreciable traffic to the Philippines and the East.

(To be continued.)

SOME SUGGESTIONS TO THE MANAGERS OF SMALL CENTRAL STATIONS.*

BY GEO. HAYLER, JUN.

AT the close of the year 1898 there were in operation in the State of Ohio 173 central stations, and of their number 88, or more than 50 per cent., were located in towns having a population of 5,000 or less. Many of these stations have been in operation for from 5 to 10 years, and have had to suffer from the lack of engineering ability displayed in their design and construction. Some have already outgrown their original equipment, and have been rebuilt in more modern lines; others, having striven unsuccessfully to make both ends meet, and satisfy the Village Council at the same time, have ingloriously given up the fight, and have been succeeded by that bugaboo of small stations, the municipal plant. Many of the small stations that have been built within the last few years are fortunate in having apparatus modern in design and economical in operation, and have been installed by men whose knowledge of the conditions to be met has put them in a fair way to return a reasonable interest on the investment; but there are still a large number of small plants, poorly designed in the beginning, and equipped with old apparatus, that have persistently refused to pay dividends in the past, and whose future looks far from brilliant, and it is with these that we are concerned.

Much has been written in the last few years regarding the economies to be effected through proper central station design, and the advantages to be gained by replacing old apparatus with new and more modern machinery, and if it were always possible to carry these suggestions into effect, as applied to our particular case, the result would undoubtedly be favourable. There is no question that, if we had it all to do over again, we could improve matters very much; but it is simply out of the question to throw away thousands of dollars' worth of equipment, and the average manager of a small station must content himself to take conditions as he finds them, and by judicious additions and alterations in his plant, necessitated by increased business, gradually work out his salvation.

* Read before the Ohio Electric Light Association, Cleveland. Mr. Hayler is manager of the Van Wert (O.) Electric Light and Power Company.

The problem, then, which confronts the manager is this: Given an electric lighting plant in a small town—how to increase the net earnings without resorting to any radical changes in the installation. There is always room for improvement, and with this idea in mind, I have undertaken the preparation of this paper, hoping that perhaps I may suggest some idea as the result of my limited experience, which may prove of value to someone similarly situated: and if I do, the purpose of this paper will have been accomplished.

Let us consider for a moment the conditions to be found existing in the average small lighting plant. We have a town, say, of from 4,000 to 5,000 people, with, perhaps, both gas and electric companies doing business. The electric plant has probably a typical equipment, consisting of one or more series arc machines, and, the chances are, an alternator. Engines and boilers have seen hard service, but, on the whole, the machinery is in fair operative condition and capable of doing good work.

The lines, perhaps, show marks of time and extension; having been made without due consideration as to the best arrangement, they will probably bear considerable attention. The transformer equipment, it is likely, consists of a number of small units operating at a secondary pressure of 52 volts, or, perhaps, if the station has been built since 1892 or 1893, at 104 volts. The chances are that the plant has still considerable reserve capacity, or, if it has not, there is a certain amount of unprofitable business, which must be got rid of entirely, or else put on a paying basis.

Now, it is evident that if the net income is to be increased, it must be done by first increasing the total gross earnings through taking in more customers; second, by reducing operating expenses. It is to the first of these requirements that I wish to call your attention more especially.

It is a regrettable fact that in small central stations the cost of operation does not bear any definite relation to the value of the total output. In every station the fixed expenses, such as taxes, insurance, interest, &c, remain the same under all conditions. The item of labour, however, in a small station is also practically a constant quantity, and the cost of fuel, water, carbon, lamps, removals, &c, while bearing a closer relation to the output, are not proportional to it.

It is evident, then, that as we increase our station output up to the economical working limit of our machinery, assuming the selling price per unit to remain constant, we increase the net profit in each unit of electrical energy produced.

The question now arises: How are we to increase our business? Let us consider for a moment the essentials for the increase of any manufacturing business. In the first place, there must be a demand created for the manufactured article. If it is something new and has the field to itself, it must be advertised and the public educated to feel the necessity for its use. If it is an article to compete with other articles of the same nature, in order to sell, it must be better or cheaper, or more convenient than that which has heretofore been produced. So it is with electric light; in order to interest new customers the customer must first be convinced that some material advantages will be the result of its use.

Before we can compete with other forms of illumination, however, we must be able to assure our customers of these things:—First, reliability of light; second, quality of light; and third and last, cheapness of light.

There is perhaps nothing more detrimental to the success of a lighting business in a small town than frequent irregularity of service. This is undoubtedly due, in a large measure, that very few small plants have sufficient reserve apparatus to tide them over any accident of a serious nature, and accidents will happen, even in the best conducted stations. It has been my experience, however, that accidents are usually the fault of someone's carelessness, rather than visitations of Providence, and that many of them may be avoided, provided that the employés of a station exercise due care and diligence in the discharge of their duties. The duties required of the average man employed about a small plant are varied in the extreme, and require much good judgment, and a large capacity for hard work and long hours. It is a mistake to suppose that anyone who is familiar with steam machinery will be the man to operate an electric plant. It is hard to teach an old dog new tricks, and it will probably cost you more to teach an erstwhile engineer of a threshing machine or a sawmill how not to do things, than it would be to take a green man and teach him how things ought to be done. Don't make the mistake of employing one of those men who know it all, and who has his pockets full of credentials from plants where he has been employed. A letter of recommendation is often a mighty cheap price to pay for the privilege of disposing with a man's services. Shun, also, as you would the Old Nick himself, the man who is continually and eternally skipping around with a monkey-wrench in one hand and an oil can in the other, adjusting everything in sight. He will make you nervous, and eventually cause you more trouble and expense than a man who sits down and deliberately neglects things until they will run no longer. Get good, sober, cool, reliable men, and then keep them; and if you can't find the men you want, get some good, young, raw material, and make them. It will take time and patience, and you will get your hands dirty, but in the end you will have men whose reliability, carefulness and loyalty, will pay you a thousand times over for the time and patience spent in developing them.

Instill into the minds of your men the fact that your interests are their interests, and that you must all pull together or not at all. Try to arrange the work so that each man has certain specified duties, and hold him strictly accountable for their performance. Give the workings of your plant a share of your personal attention. Try to familiarise yourself with the smallest details, and insist in case of anything being wrong with your machinery, that you be acquainted with the fact at once. Go over your lines once in a while, and see

that the trees are trimmed. Avoid, as far as possible, building any line on the streets, but keep in the alleys. Spend a few dollars for lightning arresters, and insist on careful inside wiring, so that every time there is a thunderstorm you do not lose a half-dozen transformers. This last point is one often sorely neglected in small towns. The interior wiring is usually something fearful and wonderful to behold. It results from the attempt to do work too cheaply, and by intrusting it in unskilled hands. This is a very serious mistake, and will eventually cause both the lighting company and the consumer an endless amount of trouble and annoyance. The main cost, then, of continuous service is eternal vigilance.

The next consideration which the use of electricity for illuminating purposes involves is that of quality of light. This is a very important point, and one in which small stations, as a rule, are great sinners. Two of the most salient features of good electrical illumination are steadiness of light and uniformity of candle-power, and unless these can be maintained the value of the electric lamp as a source of illumination is virtually lost. Let us consider briefly, first, the causes for poor quality in the arc light.

Poor arc light service has been the ruination of many an otherwise promising electric light enterprise, and has been the source from which have sprang many of the municipal plants found in small towns. The series arc lamp at best is a rather rude piece of mechanism—simple in construction, but still capable of cutting up the most uncalled for capers, just at a time when it is least desirable. It is subject to numerous diseases which have their origin, like most of the diseases which afflict mankind, in dirt and neglect. Its care is usually entrusted to the tender mercies of the most poorly paid men about the plant, and, exposed to the dust and rain, forming an ideal roost for the pesky sparrow, it is no wonder that it insists on having its wants immediately attended to by refusing to make even a spark. Insist, then, that your trimmer keeps the lamps clean. When the lamp is really out of order, have it brought in at once and repaired. Don't try to tinker it up and wait to see if it will burn that night, the chances are it won't, and you will have two nights' rebate to pay instead of one. Do not buy the cheapest carbons that you can get hold of, for they will probably be crooked and as knotty as an Irishman's shillalah, and your lamps will burn more like a Fourth of July exhibition than like good, steady arc lights. If you have a voltmeter, try your lamps and see what the voltage is across the arc. An experienced man will adjust a lamp to a nicety, without resorting to this expedient, but just try it anyway. You will be astonished at the variation in the voltage, and you will perhaps find that many of your lamps are taking 700 watts, instead of 450, while others are not up to the standard. Put your station ammeter in circuit once in a while, and see how much current you are applying to your lamps. Many a plant has gotten itself into serious difficulties by carelessness in this regard. Try and keep everything in the best possible shape, so there will be no possible chance for complaint; for there are always so-called experts roaming around with plans for a municipal plant in their pockets, who are looking for just such short-comings.

The quality of incandescent light depends, primarily, on the regulation, and is affected to a great extent by the quality of the lamps used. The secondary voltage in an ordinary small plant will be found, by making a voltmeter test, to vary from 6 to 15 per cent. This seems almost incredible, but, nevertheless, is true, and is the natural result of the methods of transformer installation in vogue up to the last few years. Among the earlier alternating plants installed, 52 volts was the standard secondary pressure. This pressure was adopted, mainly, because the 52-volt lamp will stand greater extremes of voltage without serious deterioration than will the 104-volt lamp. It was necessary in distributing this pressure to use a number of small transformer units, because the cost of copper practically prohibited the extension of secondary mains over any considerable area. This consideration of affairs gives rise to the very poor regulation to be found in plants of this nature, for while some transformers are fully loaded, adjacent ones may be carrying a very light load; and a consequent variation in voltage, due to copper losses and magnetic leakage is the result. In the attempt to give a good light to the customer, who is connected to the heavily loaded transformer, by increasing the primary voltage at the station, the pressure on the secondary of the lightly loaded transformer is increased much above normal, in consequence of which any lamps that may happen to be burning have to suffer. It is evident, then, that if we could interconnect our transformers, so as to equalise the voltage between them, we should get very much better results in this regard. Further, if we should now replace our several transformers by one large transformer, located in the centre of distribution, we should still retain the advantages to be gained in regulation, besides, at the same time, reducing our core losses very materially. It is quite evident, however, that the cost of copper would preclude any possibility of distributing from a large centrally located transformer at a secondary pressure of 52 volts. By increasing our secondary voltage to 104 we can cut the cost of copper to one-fourth, and by using 208 volts we can reduce the cost to a little over one-sixteenth; the percentage of drop in the lines remains the same in all cases.

Many data have lately been published in regard to this matter, and it behoves the manager of a small station to look into the question carefully. It not only means that his customers will get better service by the adoption of larger transformer units and higher secondary pressures, but at the same time the core losses, entailing more or less waste of fuel, will be materially lessened.

During the summer just passed, the company with which I am connected was compelled, by city ordinance, to remove its poles and wires from the business streets and to rebuild them in the alleys. This change necessitated an entirely new arrangement of circuits, and we determined to take advantage of the occasion to try and improve our service. In one particular district, comprising three blocks of business rooms, the lamps were formerly supplied by nine transformers, varying in size from ½ to 5 KW, and having an aggregate capacity of 465 lights. The secondary pressure was both 52 and 104 volts, and by actual measurement there was at times a variation in voltage of 6 per cent. between adjacent buildings. The total number of lamps in circuit aggregated 892, of which 179 were on contract, and 513 on meter. One hundred and fifty of these lights were in stores closing at 6 p.m., except on Saturday; 100 were in a church, and the balance were distributed among business rooms and offices. The load was heaviest almost in the centre of the district, with the church on one end, and the consumers gradually becoming fewer toward the other end. The question now was whether to use the old transformers, and connect them together with a heavy secondary tie-wire, or whether to buy several large transformers wound for 208 volts, and use a three-wire system. It proved, on doing a little figuring, that a No. 2 feeder would be necessary to connect the transformers with the pressure at 104 volts, in order to avoid a drop of over 2 per cent. at full load. The total distance to be covered was just 1,000 feet, and the cost of the wire figured almost exactly $100. By using a three-wire system, 208 volts on the outside and larger transformers, the length of some of the runs was increased, but it proved that a No. 4 wire would be amply large enough to carry the load and allow a good margin for increased business. The cost of this wire amounted to $65 40, and that of the neutral wire $15.75, or a total of $71.15, a saving in wire of $19.

There was another thing taken into consideration, however, and that was the question of core losses of the nine transformers; six were of 50 lights' capacity or less, and had been in service for some years, and the probabilities were that their efficiency was pretty low. We had no opportunity of measuring our core losses, but from some published data from some tests made by Prof. Jackson on transformers of the same type, and of about the same capacities, we estimated our core losses to be not less than 650 watts. We finally decided to instal one 250-light transformer and two 100-lighters of modern design, and we were safe in assuming that the core losses would not aggregate over 360 watts, a net saving of 290 watts per hour, which, if we assume our cost per kilowatt, delivered at the transformer company, to be somewhere in the neighbourhood of 4 cents, will amount to about $40 only. This is pretty good interest on the cost of transformers, and besides this we have the old ones, which we can use if we want to.

Another fruitful source of poor light is the use of poor incandescent lamps, but this point has been brought about so often that I need say nothing further than that the best lamps are none too good, and that the difference in cost between good lamps and poor lamps is so small as to be compensated many times over by the increased excellence of the service to be obtained, to say nothing of the economies effected in the coal pile.

The third requirement for the increase of our business is low cost of light to the consumer. The question of rates to be charged for electric light service would furnish material for several papers, and I can but touch upon it here. In a small plant, having no gas competition, the rates will be governed largely by the customary charges for similar service in towns of corresponding size. It is absolutely necessary, however, that the matter be looked into very carefully. Local conditions may greatly affect the cost of manufacture, and it may cost more to furnish light in one town than it will in another perhaps 50 miles away. The price of coal is one of the largest factors in the extensive operation and is exceedingly variable in quantity, due to the difference in freight rates. The quality of the feed water used will also have a great bearing on the efficiency and life of your boilers, and perhaps, owing to the peculiar manner in which your town is laid out, the investment in copper necessary to be distributed over it may be several times that required in a neighbouring town of the same population.

In towns where we have gas competition the question assumes a different phase. Here the price in regard to service has a fixed limit, above which it is almost impossible to go and be successful. The advent of an electric company into a small town is usually the occasion of lowering of gas rates in the hope of discouraging electric light. And the first clash of arms is likely to be prolonged into a rate war, which will continue until the companies get together and make some kind of a working arrangement by which both can live, or else consolidate their interests.

In considering the advisability of lowering rates, the first thing to be taken into account is the strength of your adversary. How long can he hold out at the prices which he will be compelled to make in order to meet your competition? A point not to be overlooked is the fact that lowering rates will be accompanied by increased consumption, and, owing to local conditions, your adversary may be able to make more net profit per cubic foot of increased gas consumption than you can make on an equivalent of increased electrical consumption; and, if this is the case, your last state is worse than the first. Try to avoid, if possible, ruinous competition. Above all things, do not make the mistake of charging a half-dozen prices for the same amount and class of service. It will cause you more trouble and lose you more customers than any other policy which you might adopt. Confidential rates are a bad thing to trifle with, for in the end they will prove to be a boomerang.

(To be continued.)

Lancashire Electric Powers Bill.—A conference of municipal corporations has been convened for the purpose of considering, and, if thought desirable, opposing, the Lancashire Electric Powers Bill, which deals with all the local authorities in the County of Lancaster, except those north of the Ribble. The conference will be held in the Lord Mayor's Parlour at the Manchester Town Hall on Tuesday the 23rd inst., and will be presided over by the Lord Mayor.

THE ELECTRICAL FIRE BOGEY.

By L. M. WATERHOUSE, A.M.I.C.E. and E.E.

The much-debated wiring question is again coming to the front, and is receiving a large amount of attention in the columns of the electrical and general press. The fact is also growing more and more apparent that on this important subject authorities agree to differ, as they have previously done, and in all probability will continue to do.

There is, however, no dearth of suggestions; some practical and to the point, others very much the reverse. These suggestions emanate from all sorts and conditions of men, some having pet theories which they are most ready to expound, and others are as ready to criticise (in a friendly (?) spirit) and as promptly extinguish, before proceeding to launch out on their own method, which, of course, is the one to settle the vexed question. Some, again, relate their experiences with this and that system of wiring, and straightway draw conclusions, in many cases far from logical. So the battle of the rival systems is fought and re-fought, until the long-suffering electrical editor takes pity on the profession, which stands aghast at the multiplicity of suggestions presented and conflicting experiences related, and the "Correspondence" columns are closed to this question for a season.

The scene of battle is then shifted to the columns of the general press and exposed to the eyes of the general public, who are at first inquiring, then interested, then anxious, and finally alarmed at the forebodings and warnings of wholesale devastation which are hurled against the various wiring systems by the opposing parties. When eventually the fight wears itself out, or receives its *quietus* in the form of a notification that "This discussion is now closed," we begin to look round us for the *casus belli*. What is it? Where did it originate—this dreadful electrical fire risk, which has created a feeling of uneasiness and insecurity, and to some extent threatened the growing popularity of electric lighting? Echo answers "Where?" We know it not; inquire of the fire insurance offices—they know it not, nor do their statistics show that it has any existence. Ask the electrical engineer in his professional capacity, and will he not repudiate with vehemence the mere suggestion that electric lighting can be anything but the safest of all illuminants? Sound him further, and he will confess that the fire risk is but a "bogey," a dream of what might have been had the wiring industry not progressed and kept pace with the developments in other branches of the electrical industry. But alas! to him is due the periodical unearthing of this "bogey," for such is his love of argument that he cannot leave it long buried in obscurity, and at each unearthing the same programme is repeated and the same result achieved, while gas managers smile and leave him to the discussion of his magnified dangers, distorted facts, and far-fetched imaginings, and at the same time wonder what he would do had he to deal with such realities as gas fire risks and explosions. Where do we find gas managers discussing such matters in the general press, and in this manner intimidating the public? Surely the wisdom of electrical men surpasses comprehension! Have we to thank the gas engineers for starting this scare? Certainly not. Was it then some electrician who purposely wished to retard the development of electric lighting? This is not probable. Who then? Could it be a man with a special system, say, "the only safe and fire-proof system," and did he expound the doctrine that "except ye instal my system, and pay my price, ye cannot be safe from this fire bogey." (Did he get medals?) Well, perhaps it was so, and once having raised the ghost, he is unable to lay it. Nevertheless, the curve of lamp connections at our central stations is still rising, fire insurance offices continue to take up electrical risks, and information supplied by them, supported by the evidence of their capable inspectors, does not appear to bear out the fact that electrically originated or urged fires are as yet quite an everyday occurrence. One is therefore apt to be somewhat curious as to the genuineness of this "bogey" of Yankee origin which is being continually pushed to the front; no doubt for some disinterested purpose—but what?

SOME INTERESTING FAULTS ON TELEPHONE CIRCUITS.

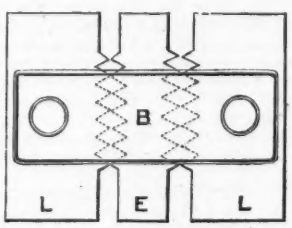
By "BUSYBACK."

Faults on telephone and other circuits are due to a variety of causes, which, for our present purpose, may be put under the following heads: storms, electric light or power circuits, faulty construction and ordinary wear and tear.

Ordinary storm faults are caused by poles, wires or other parts of the outside circuit breaking down because of the excessive strains to which they are subjected, thus causing disconnections, short circuits, and earth faults. Such faults as these are of frequent occurrence and of no special interest, so they need not concern us further at present.

Some of the most interesting faults which come under the first heading are those due to lightning discharges. It is not an unfrequent occurrence for the line wire to be fused or damage done to the instruments by a flash of lightning; although all telephones which are intended for use on long distance circuits are provided with lightning arresters, lightning may disconnect or short-circuit them. One of the best forms of lightning arrester which has been fitted to telephone instruments has the disadvantage that while it prevents the instrument from being damaged by a lightning discharge, it is frequently found short-circuited after a storm. The construction of an arrester of this form will be understood from the accompanying sketch (fig. 1), where L and L are two toothed plates in connection with the A and

Fig. 1.



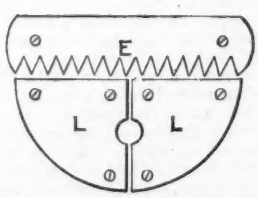


Fig. 2.

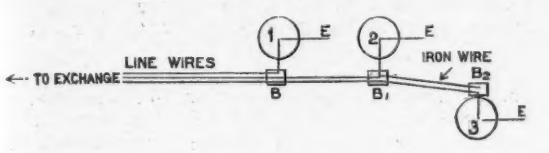
B wires of a loop circuit, E is a third toothed plate which is earth-connected, a piece of thin paper is laid over these and held in position by the strip of brass, B. When a lightning discharge takes place a spark frequently passes from the line plates, L and L, to the bar, B, and from this to the earth plate, E, making a small hole through the paper and carrying with it, in each case, a burr of metal which is sufficient to short-circuit and earth the instrument; this prevents the coils of the instrument from being damaged, but it will be useless till the piece of paper is changed.

For an ordinary pattern of telephone lightning arrester to fail in preventing a discharge through some of the coils of the instrument is a very common occurrence; most frequently it is the bell coils which suffer and are fused, though not always. In one case of a fault caused by lightning, which I distinctly remember, one of the coils of the double-pole receiver was fused; as it was impossible to change the disconnected receiver at once, the faulty coil was taken out of the circuit and the receiver left working on one coil. A few days later there was another thunderstorm, during which the remaining coil of the receiver was fused, and consequently the instrument was rendered useless till the receiver had been changed. The cause of this fault was a badly made lightning arrester which did not admit of proper adjustment.

An ordinary pattern of lightning arrester, as fitted to a telephone, is made as follows:—L and L are two plates in connection with the lines, E is the toothed plate which is earth-connected. The three plates should be adjusted so that they are about $\frac{1}{100}$th part of an inch apart.

One of the most interesting cases of damage by lightning which has come under my notice, occurred two or three years ago, and affected three separate circuits. The sketch of the positions of the affected circuits (fig. 3), will make clear what follows. Circles 1, 2, and 3, represent three different houses with an ordinary telephone in each; B, B_1, B_2, represent small brick chambers with iron lids flush with the footpath, these chambers were joined together by earthenware pipes in which the wires (18 gauge copper, insulated with gutta-percha and braided), leading from the exchange, about a mile away, were placed. Between chambers B_1, B_2, there was one insulated wire and a length of No. 8 gauge galvanised iron wire with the ends left loose in each chamber, this wire was only to be used for the purpose of drawing other wires through the pipes. According to the inhabitants of the houses there was a very vivid flash of lightning, followed immediately by a loud peal of thunder; this flash of lightning

FIG. 3.



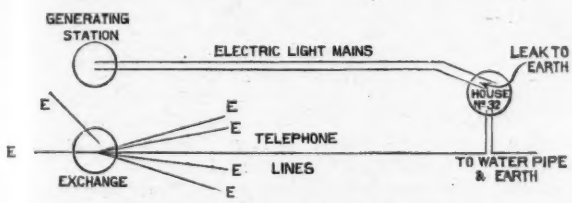


FIG. 4.

fused the bell coil of No. 1 telephone, fused the induction coil secondary of No. 2, fused the wire and burnt through the gutta-percha covering of the wire to No. 3 telephone, midway between chambers 2 and 3, and also fused the No. 8 galvanised iron wire which was lying in the pipe volatilising some of the zinc, which settled on the insulated wire for some distance. Instrument No. 3 was not damaged at all, and no damage was done in the exchange, beyond some of the lightning arrester points being burnt off and blackened by the discharge to earth.

The interesting point of this case of damage is that all the wire was underground, and the ends of the wires terminated in buildings, the wire could not therefore have been "struck," and the damage must have been caused by the return shock.

The points of toothed lightning arresters are frequently burnt off by discharges; other forms of arrester may have small pieces of metal torn off.

During a heavy thunderstorm in the neighbourhood of a telephone exchange, nearly the whole of the line indicators fall simultaneously; if the storm is some distance away from the exchange, lines in the neighbourhood of the storm pick up currents which are frequently strong enough to drop the indicators on these lines.

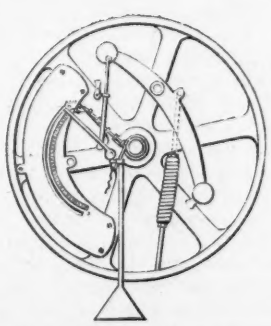
Electric light and power circuits nearly always cause a certain amount of disturbance on telephone circuits which are worked on the single wire system, now rapidly going out of date. When the light or power circuits are faulty, some curious troubles are experienced in the telephone exchanges, or on separate circuits which are near the affected circuits.

On one of my visits to a certain telephone exchange a short time ago, one of the operators complained that indicator No. 32 frequently fell and could not be replaced for some time, though no one was trying to call central from the distant end; this most frequently occurred at stated times in an evening, and the current would sometimes be on the line for an hour or more, then all would be right again. This went on for several days, and as careful examination of the instrument and line did not show any defect, nothing was done. Shortly afterwards, the operator reported that the whole of the indicators, about 150, had fallen simultaneously several times. Inquiries at the house in which telephone No. 32 was situated revealed the fact that some electric light men were at work in the house; on cross-questioning them it was found that there was a leak to earth of 10 amperes when the lights in the billiard-room were turned on. The nearest telephone wires were 40 or 50 yards from the billiard-room, and these were carefully insulated. The cause of the trouble was this:—The telephone line was a single wire circuit with an earth return, the exchange was near the generating station, the current leaking to earth from the billiard-room must find its way back to the generating station, so a portion of it travelled along the water pipe, to which the telephone earth wire was soldered, along the earth wire, through the instrument, line wire and indicator at the exchange, to earth there, and so to the generating station.

When the leak to earth was stopped, no more trouble was experienced in the telephone exchange. The diagram (fig. 4) will make the paths of the currents clear, and will also show why more than one indicator should sometimes drop. There must have been an earth in the generating station or near it, or the current would not have leaked back from the fault in house No. 32 to the station. The cause of other indicators dropping, as well as and at the same time as No. 32, was because one end of each of the indicator coils in the exchange was connected to the same earth wire, and their other ends, through spring jacks, to the various line wires. As the earth wire would have some resistance, the current would divide through all the paths to earth provided by the indicators, line wires, instruments, and earth wires at the various houses near the generating station.

ELECTRICAL FLY-WHEEL GOVERNOR.

A COMBINATION inertia and resistance governor, which is said to have given excellent results in practical tests, and which, for incandescent lighting, seems to be all that can be desired, has been devised by Mr. E. E. Clock, and is described in a recent issue of the *Electrical World*. The accompanying illustration is almost self-explanatory; the bob-weights and helical spring control the position of a switch arm, which varies the resistance in the exciting circuit of the dynamo,



ELECTRICAL FLY-WHEEL GOVERNOR.

connection being maintained by means of brushes bearing on slip rings. The resistance coils must, of course, be contained in the fly-wheel, where they have the advantage of excellent ventilation.

It is claimed that this arrangement is superior to the ordinary engine governor, in that its action does not depend upon a variation of the very thing (*i.e.*, the speed) which it is intended to maintain at a constant value, while it is better

than an electrical governor, which similarly depends upon the pressure which is to be kept constant. It must be admitted that this holds good, for no ordinary governor can raise either the speed or the pressure to a higher value than the normal as the load is increased, whereas the regulator in question can be adjusted to give a constant, a rising, or a falling pressure as the load increases.

Its range is, of course, somewhat limited by considerations of magnetic saturation on the one hand, and commutation on the other, but is still wide enough for most practical purposes; while the applicability of the system to turbines in particular, which are notoriously difficult to govern, is worth consideration. There is nothing to prevent the use of an ordinary governor simultaneously with the Clock governor. The latter would at once compensate for sudden fluctuations in speed, while the former, acting more sluggishly, would restore the speed to the normal value, or thereabouts, at leisure.

The weak point appears to be the possibility of interruption of such an important circuit as the shunt winding; but this danger may be avoided either by placing the governor in a "teaser" circuit, quite independent of the main shunt winding, or by shunting the governor leads with a fixed resistance of suitable magnitude. For that matter, there are hundreds of alternators working satisfactorily with sliding contacts in their field circuits; but, of course, the rotating rheostat and switch arm form an added risk in this instance.

Whether the device could be successfully applied to alternators in parallel, driven by independent engines or turbines, is somewhat doubtful, owing to the special conditions under which these machines are run; but even in this case we see no insuperable difficulty.

Finally, we may point out that it is not essential that the resistance be contained in the fly-wheel; the inertia governor may be used to vary a stationary resistance entirely separated from the moving parts.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The "Report of the Institution Visit to Switzerland" was the subject down for discussion at the last meeting of the Institution; in other words, electrical engineering practice generally was left to the tender mercies of the speakers. The report was taken as read, and Mr. Crompton opened the discussion by a comparison between British and Continental practice in electrical engineering; but preceding this was the notification that Messrs. Byng, Bathurst and another had presented 100 guineas to the building fund. The money was understood to have been found by a well-known electrical firm, and to have come the way of the Institution by a combination of circumstances of which most of our readers have already an idea. Mr. Crompton thanked the members and others for the response given to his circular regarding the Electrical Engineer Volunteers who are about to proceed to the Cape. The primary object was to place men and officers at the disposal of the Government, so that use might be made of the scientific and practical knowledge of those familiar with modern electrical work, and also organised and drilled. The offer was accepted provisionally, and instructions are now awaited. The Government will supply all the equipment and apparatus. The money asked for will be spent in providing personal comforts for the men; £900 had been received, and Mr. Crompton hoped to get £1,400. The men were to go out not as a fighting party, but as saving or economising life by shielding the soldiers and facilitating work at night. While the work was of a humble nature, he was afraid that so far we had trusted too much to men and pluck under fire, rather than to good engineering and high scientific qualities.

Coming to the discussion proper, Mr. Crompton congratulated the committee on the visit and report, which was very valuable, as showing the state of Swiss electrical engineering at the time; while the photographs ought to be very valuable in time to come. One of the things that impressed the visitor was the quietness of the trolley cars. Swiss engineers were not afraid of a rise of temperature in their machines that would rather frighten English consulting engineers. In Switzerland coal was dear and water-power common; transmission of power by rope and mechanical means was in use years before electrical transmission was attempted. He found that in 1882, two dynamos were ordered from Crompton for transmission of power, the first electrical plant in Switzerland. There was a great advantage in having examples of the best engineering practice continually before them.

The Sulzer engine works must have impressed many, and he had not thought it possible that large steam engines several months in the shops could have been kept in such perfect cleanliness, neatness, and finish, without a scratch on the polished parts, but progress was not very rapid. A high price was obtained for the work, and the dynamos were built to fit engines of the horizontal low speed type, with the result that fly-wheel alternators were well developed. On the other hand, we had Willans' engines, and had principally developed high speed machinery. In Switzerland there was little lighting but much transmission of power, and the Swiss were not level with us in lighting and continuous current plant, as for instance, the 2,500 H.P. sets for Manchester.

The three-phase railway work showed unexpected simplicity, and the overhead construction with two trolley wires was not nearly so bad as might be expected. The switch gear was remarkably simple; on the switchboards a notice in big letters was placed, which being translated read:—

THINK WHICH,
THEN SWITCH.

Several slides were shown, some of which, giving snapshots of groups of members in more or less artistic attitudes, caused much amusement to the meeting.

Mr. Hammond remarked that the whole time was not occupied in scientific work, but if critical at all he thought they worked too hard. With three or four inspections in a day of from 6.30 a.m. to 10 p.m. one got tired. He congratulated Mr. Crompton on his *résumé*. The splendidly equipped engine work influenced the whole Swiss nation. The dynamo work had not struck him so much as the engine work.

No costs were given by the Swiss engineers; apparently the cost per unit was not known anywhere in Switzerland, engineers were concerned with engineering, and it was pleasing to find engineers had such important positions. Consulting engineers were kept on the spot instead of one consultant taking the responsibility for several works. After some remarks on the relation of coal to total costs, it was pointed out that the real lesson was the aggregation of load at one centre.

Mr. Swallow stated that he was astonished to see that three-phase was not used direct on the Central London Railway: there seemed to be little gain in conversion. Prof. Carus-Wilson naturally alluded to traction work and referred to several railways, and the Brown-Boveri kccos. and gearing. He particularised the small clearance in polyphase motors, only 1½ mm. on the radius for machines running 600 revolutions per minute. After a few remarks on crossings, he mentioned that on a 25 per cent. grade the train was held by the return current, and that a 5 per cent. speed greater than synchronism caused the return current to act as a powerful brake. The power houses were not put down for a single town, but for 100 villages.

Amongst other remarks Mr. Robinson criticised the importance apparently attached to small clearance (of 1½ mm.) and thinking it was over estimated, said that "one could walk through a space of 1 mm."

Mr. Raworth's most humorous contribution was a reference to the return current brake on a 25 per cent. down grade. He had often had cause to perspire, but had he known he was coming down depending upon this for safety he would have been in a greater perspiration than he had ever been before in his life.

The discussion will be worthy of careful perusal when the *Journal of the Institution* appears, but did not lend itself to summarising, as the full report should be read in conjunction with many of the remarks.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

27. "Improvements in electric arc lamps." H. LYON and J. B. TALBOT CROSBIE. Dated January 1st. (Complete.)

35. "A method of and apparatus for drying insulated wires for electrical purposes in the process of winding." H. HIRST and T. HAWKINS. Dated January 1st.

45. "Improvements relating to electrical incandescence lamps of the newest type." V. I. FERNY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated January 1st. (Complete.)

63. "Improvements connected with ceiling roses of electric incandescent lamps." J. DOUST. (Messrs. Schmahl & Schulz, Germany.) Dated January 1st.

65. "Improvements in the manufacture of electric conductors or cables." G. C. ALLINGHAM and W. FENNELL. Dated January 1st.

81. "An electrically-operated clip to be employed in machines for tentering and stretching fabrics." W. WHITELY and W. WHITELY, jun. Dated January 2nd.

87. "Improvements in single-phase induction motors." W. G. RHODES. Dated January 2nd.

93. "Improvements in or connected with the manufacture and production of pipes or conduits for electrical conductors or for conveying liquids, gases, or for analogous purposes." A. H. HOWARD. Dated January 2nd.

100. "Improvement in regulating the supply of gas, electricity, or any other matter for illuminating and heating purposes." B. W. HOUNSELL. Dated January 2nd.

105. "Improvements in electric lamps applicable for advertising purposes." T. MASON. Dated January 2nd.

115. "Improvements in advertising by means of electric lamps and apparatus therefor." J. RICHARD. Dated January 2nd.

138. "Improved method of telegraphing, indicating time, or actuating mechanism electrically." C. R. LOUBERY. Dated January 2nd.

146. "Speed governor attachment for electrical apparatus." J. H. MCGURTY and T. MCEWAN, jun. Dated January 2nd.

147. "Improvements in electric water filters." W. L. TETER and J. A. HEANY. Dated January 2nd. (Complete.)

159. "Improved means of taking up the slack of flexible wire cord or other material used in electric or other fittings." A. H. C. GIBSON and E. G. MILES. Dated January 3rd.

163. "Improved automatic make and brake for electric circuits." P. C. MCFARLANE and D. REID. Dated January 3rd.

164. "Improvements in or in connection with electric incandescent lamps." C. M. STEAD and G. F. CARR. Dated January 3rd.

174. "Improvements in electrically-driven cranes and similar machines." F. H. ROYCE. Dated January 3rd.

176. "A current receiver for electric railways" H LACHENMEYER. Dated January 3rd. (Complete.)

178. "Improved means of making the electrical connections with carbon electrodes." H BAKER. Dated January 3rd.

182. "Improvements in electric ignition devices for internal combustion engines." P. W. NORTHEY and the ELECTRIC MOTIVE POWER COMPANY, LIMITED. Dated January 3rd.

184. "A new or improved method of determining the voltage obtaining at a near or distant part of an electric circuit or the average voltage obtaining at several parts thereof and apparatus therefor." M. B. FIELD. Dated January 3rd.

201. "Improvements relating to conduits for electric railways." R. BELFIELD. Dated January 3rd.

216. "Improved manufacture of active mass for accumulator batteries.' R. RODRIAN. Dated January 3rd.

240. "Improvements in or relating to magnetic brakes and magnets suitable therefor and for other purposes." T. VON ZWEIGBERGK. Dated January 4th. (Complete.)

246. "Improvements in automatic electric switches." F. H. HEADLEY. Dated January 4th.

247. "Improvements in electro-magnetic mechanism suitable for use in indicators, relays, bells and the like." F. H. HEADLEY. Dated January 4th.

248. "Improved electric switch mechanism." E. B. VILES. Dated January 4th.

254. "Improvements in subterranean conductors for electric railways." J. LEVERSON. (K. Zebisch and J. Steinbach, Austria.) Dated January 4th.

260. "Improvements in apparatus for the generation and electrolytic application of electric currents." F. E. ELMORE. (Partly communicated by J. O. S. Elmore, India.) Dated January 4th.

261. "An improvement in safety electric fuses." H. C. GOVER and J. M. MOFFAT. Dated January 4th. (Complete.)

264. "Improvements in apparatus for wireless telegraphy." G. MARCONI. Dated January 4th.

293. "Electricians' pocket companion." W. DUTHIE. Dated January 5th.

314. "Improvements in X-ray lamps." H. A. KENT. Dated January 5th.

361. "Double link detachable chain for electric light purposes." A. H. MCNAUGHT. Dated January 6th.

367. "Improvements in or relating to the means for adjusting or regulating the shades or covers employed in connection with electric lights or gas lights and others, for the purpose of concentrating and diffusing the light therefrom in any desired or required direction and apparatus for effecting the same." M. CRANKSHAW, A. CRANKSHAW, and H. CRANKSHAW. Dated January 6th.

396. "Improvements in electricity meters." M. BEHRENDT. Dated January 6th.

399. "Improvements in telephone call stations to be rendered operative by the insertion of a coin." A. CHABAUD and E. CHABAUD. Dated January 6th.

400. "Improvements in electric arc lights or lamps." C. A. LOE. Dated January 6th.

ELECTRICAL PATENTS OF 1886 EXPIRING IN JANUARY, 1900.

We are informed by W. P. Thompson & Co. that of about 100 applications for electrical patents were filed in January, 1886. Some were never completed, and of those that were only one has been maintained to run its full term, viz., 14 years; this being of considerable interest, we give a short abstract of it below:—

668. "Improvements in electric telegraph printing receiving instruments." F. H. W. Higgins. Dated January 15th, 1886. The receiver has type wheels driven by clockwork, and controlled by an escapement, the lever of which is actuated by the polarised armature of an electro-magnet excited by alternating currents. The printing magnet is actuated by a prolonged impulse. The escapement wheel, of particular form, is attached to a shaft and is controlled by the anchor actuated by the polarised armature oscillating between the poles of the electro-magnet. The escapement wheel is connected to the driving mechanism through the coiled spring and pinion, which fits loosely on the shaft, but is limited in its motion by stops; recoil is prevented by a fine ratchet wheel and pawl. The clockwork is provided with means for winding up without interfering with the working of the apparatus. Inking rollers bear lightly on type wheels attached to a boss, and sliding on the escapement shaft. A collar with the stop prevents the type wheels from sliding along the axis. The wheels are connected to the axis by the pin which is attached to the axis, and also engages in holes in one of the wheels. 6 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

29,505. "Improvements in magnetic telegraphy and telephony." O. J. Lodge. Dated December 13th, 1897. Relates to a system of signalling by means of magnetic induction transmitted from a horizontally placed ring or coil of wire spread over as large an area as possible and received by a similar ring, or, if the ring be not out of the same dimensions, it is syntonised so as to respond to the magnetic impulses emitted from the transmitting ring. The specification describes the use of alternators, induction and Tesla coils, batteries and rotating commutators, vibrating strings with contacts, and other methods of generating the sudden, periodic, or alternating fluctuations of current necessary to produce the magnetic waves. A simple form of the transmitting and receiving arrangements is shown in which is the horizontal field coil, an alternating generator, the transmitting key, a condenser, period-adjusting device consisting of a solenoid and movable core. At the receiving station a telephone is shown in place of the key, and two parallel coils in place of the adjusting solenoid and core. The coils may be formed of a single ring of uninsulated wire raised above the ground, or of insulated wire laid on or sunk into the ground. Where space is limited, a coil of wire may be employed with or without a magnetic core. When a core is employed, it may have a central flue for heating. The coils may be placed round or in lighthouses, ships, &c. In some forms of working a duplicate of the coil may be formed with a closed magnetic core, this coil being always in circuit when the transmitting key is at rest. The system may be arranged with a microphonic transmitter. At the receiving station various forms of telephones may be employed, both in series and parallel to the condensers, and also a tone telephone consisting of a magnetic fork of adjustable pitch attached to a sounding board and having an inducing electro-magnet between its prongs. In a second form a polarised electro-magnet has a reed armature carried by the free end of the polarising magnet. Various means of sending a call are described, including the high notes produced by the oscillations of induction sparks. Phonoporic and telephonic relay apparatus and relays for recording signals are referred to. The provisional specification also refers to the use of coherers in the receiving circuit. 10 claims.

29,586. "Improvements in methods of and means for regulating alternating current dynamo-electric machines or distribution systems." The British Thomson-Houston Company, Limited. (E. W. Rice.) Dated December 14th, 1897. Relates to regulating or compounding alternators, rotary transformers, &c. In a dynamo the field coils are energised by an exciter without rectifying any part of the main current, which is connected with the armature coils of the exciter either directly or through a suitable inductive connection. The connections between the armatures are so made that the polarities induced in the exciter armature are of opposite sign to the adjacent field poles and somewhat ahead of the field magnetisation. In some cases the polarity may be of like sign. The machine is thus compensated for variations of load and also for variation of lead and lag in the main current. One arrangement is shown in which the field coils are in series, and are supplied from the commutator. The armatures are mounted on the same shaft, and the main current flows through exciter armature connections being made at points on the same. When the armatures are mounted on the one shaft they must be driven synchronously or at suitable relative speeds depending upon the number of field poles. This method of regulating may be employed in multiphase machines and systems and for motors and the like. 11 claims.

29,586. "Improvements in or relating to electrical transformers." The British Thomson-Houston Company, Limited. (W. S. Moody.) Dated December 14th, 1897. Relates to the arrangement of the coils on a single-circuit core so as to give satisfactory regulation when the load becomes unequal on the different branches of a three-wire system. An arrangement is shown with a two-wire system supplying the primary, the secondary of which is connected to a three-wire system. The two primary coils, one on each leg, are connected in series. The secondary is divided into coils, 1, 2, 3, 4, which are connected in pairs, the coils of each pair being mounted on separate legs. The coils, 1, 4, are connected between the first main and the neutral wire and the coils 2, 3, between the second main and the neutral wire. The coils should be at a substantially equal inductive resistance from the primary. Transformers may be similarly arranged when both primary and secondary are three-wire systems, or where the primary is a three-wire and the secondary is a two-wire system. 6 claims.

29,587. "Improvements in and relating to dynamo-electric machines and electric motors for electric railways." The British Thomson-Houston Company, Limited. (E. D. Priest.) Dated December 14th, 1897. Relates to the construction of dynamos and electric motors, and more particularly to the armature shaft bearings and means for lubricating the same. The invention is described in connection with an electric railway motor. The field-magnet frame is constructed in two parts enclosing the armature; these, when bolted together, are supported at one end by the car axle, and at the other by a spring-supported bar on the truck. The bearings are mounted in boxes detachably secured to the lower half of the field-magnet frame. The boxes are provided with inwardly projecting lugs, forming guides for the brasses which are provided with adjusting screws capable of being locked at their outer ends by cotter pins. The bearing-box is divided into two communicating compartments each of which is packed with cotton waste saturated with oil. To prevent oil from working into the motor, a flange or lip encircles the oil-thrower on the armature shaft; in addition to this, a second oil-thrower is mounted on the said shaft and enclosed in a small auxiliary chamber communicating with the outside of the motor. 9 claims.

29,588. "Improvements in the method of and means for braking alternating current induction motors." The British Thomson-Houston Company, Limited. (E. W. Rice.) Dated December 14th, 1897. Relates to a method of and means for braking an electric car or other mechanism driven by one or more alternating current induction motors, which method depends upon the conversion of these motors into generators. For this purpose a switch is provided for cutting off the power circuit from the induction motors, and for connecting them in a local circuit containing resistances and a phase setter in the form of a synchronous machine with continuous field excitation, driven from the armature shaft of one of the motors. The synchronous and induction machines are so designed or geared that the latter will be driven above synchronism, when they will act as generators supplying energy to the local circuit. 8 claims.

29,589. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (E. Thomson and C. E. Harthan.) Dated December 11th, 1897. Relates to arc lamps. A clutch lamp with enclosed arc is arranged as shown in section, especially to work on constant potential mains. A series resistance is placed within a casing which is open above and below. A series solenoid is secured in an iron casing and acts to lift a tubular core attached to a tube which slides vertically and contains the upper carbon. This tube is connected to two angular levers which carry jaws and are pivoted to a yoke movable vertically on fixed guides. When the core, tube, and the angular levers are raised, the jaws grip and lift the carbon; when these parts are lowered sufficiently, a yoke is stopped by the heads of the guide-rods and the jaws release the carbon. The upper carbon is inserted in a weighted socket provided with projecting springs, and sliding in the tube. The upper end of this tube is attached to the piston of a fixed dash-pot. Or the tube may carry a crosshead supporting two dash-pots, below which plungers are fixed. A lateral opening in the tube affords access to the upper carbon for the purpose of removing it if broken. The lower carbon is placed in a detached split socket, and is then pushed up through a short insulated tube in a yoke, and the socket is secured by a screw cap. The short tube is tapered so that it compresses the socket on the carbon. The inner globe rests on the short tube in the yoke. Its neck is within a cap fixed thereon, and is secured by coiled springs, which are pressed against it by raising a bevelled ring within the cap by means of a screwed sleeve. The ends of the springs engage the fixed parts to prevent turning. The outer globe is secured in a cup supported on a yoke on beaded rods, which slide in tubes and serve to support the globe in a lowered position. The cup is made with bayonet slots, and, when raised and turned, it receives and engages pins on an extension on the yoke. The globe is thus held up against a cover, which is pressed down by springs. 10 claims.

29,590. "Improvements in and relating to dynamo-electric machines and motors." The British Thomson-Houston Company, Limited. (E. D. Priest.) Dated December 14th, 1897. Comprises various detail improvements in the construction of dynamos and motors, more particularly such as are designed for propelling vehicles on electric railways. The field magnet frame is cast in a single piece, and is provided with removable frame heads which completely enclose the ends of the motor. The bearings are formed by inwardly projecting parts of the frame heads, which support the brasses and extend under the overhanging ends of the armature winding and commutator shell so as to economise space. The frame head is formed on its inner side with curved flanges, which receive the oil cast off by the oil throwers and, in the latter case, direct it into the external cup: similar provision is made at the opposite end for receiving the oil from an oil-thrower. A cover encloses a chamber in which are placed oil and waste for lubricating the armature shaft. Dust is excluded from the shaft by a spring cover. Each of the field poles is surrounded by a cast-metal spool or by a sheet-metal punching which supports the coil. Laminated pole-pieces are secured to the field-magnet by bolts; the laminæ of which they are composed have their curved edges partly concentric and partly eccentric with the armature. The armature has a laminated body mounted on a sleeve formed at one end with a flange, between which and the head it is clamped by a nut. An extension of the flange forms a support for the overhanging ends of the armature conductors. The commutator segments are mounted on a shell secured to the shaft, and are held between a bevelled extension and an adjustable clamping-ring. Doors are provided for obtaining access to the commutator or field coils. The brush holders may be carried by a ring mounted on the inner side of the frame head, and capable of being rotated so as to permit of the brushes being inspected, but normally held in position by a locking device. The brush boxes or sockets are shrunk on to elliptical studs carried by plates capable of being adjusted on the ring. The carbon brushes are maintained in contact with the commutator by spiral springs. For the purpose of dismounting the armature for repairs, the motor is placed on a truck running on rails in a suitable framework; the armature shaft is supported between a fixed and an adjustable centre, as in a lathe, and after unscrewing one of the frame heads the field magnets are moved aside on the track. 18 claims.

29,595. "Improvements in electric heaters or rheostats." F. Kraemer. Dated December 14th, 1897. The resistances used are thin carbon rods supported by being embedded in composition in a metal case or tube. A flat case of iron, with two gauze sides, may be used. The composition used must have a similar coefficient of expansion and contraction for temperature variations to that of the carbons, and for this purpose there may be used a mixture of 10 parts of baryte to one of silicic acid by weight in a placid state. Or six parts of pulverised granite, two of pebbles, and one of lime, silicic acid, and dextrin may be used. The carbons are attached to terminals by wires passed through perforations in the carbons and fixed by metal clasps. They may be connected in series, and to the studs of a rotatable switch, by which any number of the carbons may be placed in a circuit. 4 claims.

29,665. "Improvements in telephone switches." G. Ritter. Dated December 15th, 1897. Relates to telephone exchange systems in which a central line battery is employed and also a central battery either between the plugs or in a branch for use with the clearing-out indicator. An arrangement is shown when metal and earth circuits are employed. The subscriber's indicator is provided with a resetting coil automatically operated by the insertion of the answering plug. The clearing-out indicator has an automatic resetting coil momentarily put into circuit by a switch when the magnet is excited by the insertion of the calling plug. The insertion of the calling plug by means of the magnet and switch cuts out the operator's telephone and inserts the coil of the clearing-out indicator. The apparatus is also arranged for use with alternating currents, in which case the magnet is duplicated, one armature playing between the two magnets, and having a dash-pot air case. In the case of metal loop circuits, similar arrangements to the above-described are employed, but the plug seats are provided with switch contacts, which are normally open. 5 claims.

29,676. "A union box for electric mains for lighting, traction, power, or other purposes." F. D. Black. Dated December 15th, 1897. Consists of a box or case formed of a raised portion surmounting the opening of a conduit. The case is provided with upper and lower perforations for ventilation, and may also have a door for access to the conductors which are preferably brought up into the box in arch form. 2 claims.

29,710. "Improvements in electric accumulators." D. Browne and P. Kampardyk. Dated December 15th, 1897. The electrodes consist of a number of balls, such as lead shot, or of grooved cubes, or of grooved bodies of other shapes collected together in suitable cells, and having in them conductors of forked shape or with spikes. The electrodes are separated from each other by perforated plates. 3 claims.

29,726. "Improvements in electric heating devices." F. Le Roy. Dated December 15th, 1897. Relates to a method of heating by electricity. A rod of material of high specific resistance is connected between leading-in wires in a glass vessel which is filled with an inert gas, or exhausted, and provided with end caps. Such devices are used as radiators, in stoves, for warming rooms, cooking, or other purposes. The resisting material may be silicon powder, compressed with or without an agglutinant, and baked. Specification No. 23,854, A.D. 1895, is referred to. 2 claims.

29,778. "Improvements in telegraphy." L. B. Miller. Dated December 16th, 1897. Coherers for receiving Hertzian wave signals are preferably mounted on taut wires which can be agitated for de-cohering by means of a serrated or milled bar. The milled bar is pivoted to a trembler bell lever and carries an adjustable guide stirrup. The coherer may be in the form of a metal tube with a central insulated wire passing through, or the coherer may be pivoted so as to be rotated by the motion of a solenoid core or by the expansion of a wire under the influence of an increase of temperature. The provisional specification refers to magnetic filings being de-cohered by magnetic attraction. 3 claims.

29,821. "Improvements in electric heaters." T. W. Schindler-Jenny. Dated December 16th, 1897. Heating wires are embedded in a refractory insulating material upon which a metal casing is afterwards cast to form a smoothing-iron or other heater, the insulation being left partly uncovered on one side, where the wires project. 1 claim.

29,826. "Improvements in conductors for electrical machinery and in dynamo-electric machines, motors, and other electrical apparatus." J. Mills. Dated December 16th, 1897. Relates to electric conductors for use in the construction of dynamos, motors, transformers, telegraph apparatus, bells and signals, regulating devices for electric light and power machinery, measuring and testing instruments, and other apparatus, the action of which depends upon electro-magnetic induction, are made in whole or in part of a material, such as iron or steel, which has a high degree of magnetic permeability. The necessity for using separate magnetic parts, such as the cores of dynamos and transformers, is thus obviated. A conductor is shown composed of concentric tubes of soft iron with intervening layers of insulating material, and a similar conductor is also being divided into two halves separated by an insulating layer. The application of such laminated magnetic conductors to the construction of transformers, dynamos, and motors, is described in the specification 9 claims.

29,835. "Improvements in and relating to electric heaters." E. F. Porter. Dated December 16th, 1897. Relates to a means for heating by electricity. Heating wires are embedded in enamel on the blades of a rotary or reciprocating fan, operated by an electric motor, and the supply of current to both heating-wires and motor may be controlled by a curved thermostat strip linked to a switch. A handle connected with the strip is movable along a scale to adjust its position for any desired temperature. Specification No. 5,595, A.D. 1891, is referred to. 6 claims.

29,852. "A new or improved underground duct for electric railway leads, and a contact slide to work therein." H. T. Hillischer. Dated December 16th, 1897. Relates to improvements in electric railways. Conductors are set in insulation on the under face of an over-hanging rail which forms one side of the conduit opening. The conduit is formed of the sectional inverted U-shaped rail which is supported by the side and the side, the upper edge of which forms one of the running rails of the track. The opening in the conduit is closed by a number of pivoted flaps which are held in their closed position by means of springs. The collector consists of a bent insulated conductor provided on its upturned end with contact runners, and on its outer end with a screw coupling for connecting to the vehicle. The rod is rectangular in section where it normally passes through a rectangular hole in the runner block, but it is circular in its upper portion so that, on depression against the spring it can be turned through a right-angle and the collector removed from the conduit. The provisional specification describes a modified form of irremovable collector connected to the vehicle by a spring and ball joint, whilst the collector rod is magnetised by an outer coil of wire, and the supply leads are covered with iron to produce a magnetic contact. 2 claims.

29,884. "Improvements in and connected with electric locomotives." W. E. Heys. (J. J. Heilmann.) Dated December 18th, 1897. Consists of a steam and electric locomotive in which the dynamos for generating the current are driven by steam turbines. The dynamos are separately excited, and a rheostat is provided by which the current in the exciting circuit is regulated and the locomotive thereby controlled. The motors may be arranged either on the axles of the locomotive or on those of the train. The exhaust from the turbines may be used for blast purposes, or air from a fan driven by a turbine provided for driving the exciting dynamo may be employed. 2 claims.

30,020. "Improvements in prepaid electric meters." A. Soames and C. W. S. Crawley. Dated December 18th, 1897. A ratchet wheel is driven by a rocking beam which carries a pair of bulbs containing resistance coils, and connected by a tube containing mercury. The expansion of the air in one bulb by the heating effect of the contained coil drives the mercury to the opposite end of the tube, till it overbalances the beam and the circuit is switched into the other coil. The motion is transferred to the wheel through a concentric arm bearing a spring pawl with engaging bit. The pawl when free does not touch the wheel, but is applied as the rocking beam moves in the driving direction by means of a spring finger which depends from a rod on the beam, but before the movement begins, clings to a fixed hook. After the engagement of the pawl, a fork on the beam strikes the T-end and drags it to the limit of the stroke. The maximum feed occurs when there is no lost motion between the fork and T-end, but whether this feed or less is given depends on the strength of the current used, because the pawl arm is attached to a balancing system of weighted and magnetic arms. 5 claims.